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Volume LXIX October-December 1998

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A PHYLOGENETIC HYPOTHESIS OF THE GANODERMATACEAE BASED ON A POSSIBLE MODE OF BASIDIOSPORE EVOLUTION

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ABSTRACT

Different types of basidiospore of Ganodermataceae from Vietnam are illustrated, and basidiospore morphology in the family is reviewed. Typical "ganodermoid", "humphreyoid, "amauroderm-oid" and "haddowioid" basidiospores respectively characterize genera *Ganoderma, Humphreya, Amauroderma* and *Haddowia* From the observation of intermediate forms of basidiospores, the author proposes a phylogenetic hypothesis in the Ganodermata-ceae based on a possible mode of evolution of the basidiospore.

INTRODUCTION

Shape and chemical property of basidiospores are believed to be more stable under environmental constraints than many other morphological characters. For that reason, basidiospore morphology has played a key role in mushroom classification at all taxonomic levels. For instance, Singer (1986) classified the polypore genus *Bondarzewia* in suborder Russulineae in the Agaricales from similarity with the Russulaceae in spore morphology. Donk (1964) created the family Ganodermataceae to group species of polypores with double walled basidiospore.

There has been several discoveries in the diversity of basidiosporoderma structure of Ganodermataceae species. Variation in basidiospore shape has been used by Murrill (1905) and Steyaert (1972) to create genera distinct from *Ganoderma*.

In this study I examined basidiospore morphology of collections of Ganodermataceae from Vietnam, and reviewed the different basidiopore types of Ganodermataceae which have been reported in the literature. Based on these observations, I propose a phylogenetic hypothesis of the Ganodermataceae based on a possible mode of evolution of the basidiospore.

MATERIAL AND METHODS

Basidiospores of the following species from Vietnam were examined: *Ganoderma lucidum* (W. Curt.: Fr.) P. Karst., *G. fulvellum* Bres., *G. trengganuense* Corner, *G. "japonicum"* (an ambiguous name (see Moncalvo and Ryvarden, 1997) which is applied here for black, laccate collections), *G. tornatum* (Pers.) Bres., *G. australe* (Fr.) Pat., *G. pseudoferreum* (Wakef.) Over. & Steinm.(= *G. philippii* (Bres. & Henn.) Bres. in Steyaert, 1972), *Amauroderma macer* (Berk.) Torr. (= *A. exile* (Berk.) Torr. in Furtado, 1981), *A. nigrum* Rick, *A. elmerianum* Murr., and *A. juxtarugosum* (Lloyd) Imaz. (= *A. subrugosum* (Bres. & Pat.) Torr. in Furtado, 1981). Because of difficulties in identifying species of Ganodermataceae, the names given above are still tentative. Names were based on the works of Imazeki (1939), Teng (1963), Furtado (1967a,b, 1981), Aoshima (1971), Steyaert (1972), Zhao (1989), and Moncalvo and Ryvarden (1997).

Basidiospores were examined under light microscope (LM) (Amplival, Carl Zeiss, Jena) with a Cedra oil-immersed objective of 100 x, electron microscope (TEM) JEM-T8, and electron scanning microscope (SEM) JSM-35 JEOL. The LO-method of Erdtman (1952) was applied for observation of sporoderma structure in light microscopy. Additional data about basidiospore morphology in the Ganodermataceae were from Furtado (1962, 1965, 1967a,b, 1981), Steyaert (1972, 1980), Pegler and Young (1973), Ryvarden and Johansen (1980), Bazzalo and Wright (1982), Melo (1986), Corner (1983), Zhao (1989), Hseu (1990), Yeh (1990), Buchanan and Wilkie (1995), Tham and Dam (1995), and Tham (1996).

RESULTS AND DISCUSSION

This study revealed that six types of basidiospore can be distinguished in the *Ganodermataceae*. These types are as follows:

1. The typical "ganodermoid" basidiospore (Figs. 1a - c, 1e - g; Figs. 2a, b).

The typical ganodermoid basidiospore characterizes *G. lucidum* (the type species of the family) and allied species. This type is the most common in the family and is rather uniform for over 100 described species.

Basidiospores are truncated, ovoid, 7 to 25 µm in length. The double wall is very distinct (bitunicate basidiospore). The outer wall (exosporium) is hyaline and consists in a very thin membrane. The inner wall (endosporium) is yellowish to brownish, thicker than the exosporium, and ornamented with verrucose endosporic projections called echinules. Echinules are numerous, rough or thin, and, as seen in electron microscopy (Fig. 1b), joined by thin interconnectives; these interconnectives are not seen in light microscopy. From SEM images Pegler and Young (1973) reported lack of connectives in British species. In rare cases echinules are absent or too faint to be seen in light microscopy, and the spore is said to be smooth, e.g. in *G. applanatum* var. *laevisporum* (Humphrey and Leus, 1931).

There has been many discussions about the morphology and location of the germpore among other authors (see Furtado, 1962). In the ganodermoid basidiospore the germpore (the "aperture" of Erdtman, 1952) is located at the apex (see Chen and Hu, 1995). It is always large (2.5 - 4.5 µm in diameter) and should be called "large aperture" (Figs. 1a,c,d,e; Fig. 2a). This kind of aperture is characteristic of the ganodermoid and "humphreyoid" (see below) basidiospores. In light microscopy it is sometimes possible to see a cap covering the germpore (convex tectum) (Figs.1h,g; Fig. 2b); if there is no cap covering the germpore, then the aperture is concave (Figs. 1a,c,d,e; Fig. 2a) and the apex is said "truncated". Because spores with capped germpore in light microscopy lack cap in electron scanning microscopy (compare Figs. 1a,c,e and h,g), I believe that the cap can be easily removed, therefore truncated basidiospores would be basidiospores that have lost their cap.

The attachment of the spore to the sterigma is located opposite to the apex. Careful observation in LM shows that the

hilar appendix is extending beyond the perisporium, and I call this structure a pseudoaperture (Fig. 2a). This structure has already been described from *Ganoderma* basidiopores by Furtado (1962, 1965), Steyaert (1972), Pegler and Young (1973), Corner (1983), Bazzalo and Wright (1982), Melo (1986) and others. I found that this is a specific feature of the ganodermoid basidiospores (Fig. 2) since this was not observed in basidiopores of *Amauroderma* and *Haddowia*.

In some species there is a slight deviation from the typical ganodermoid type in that the echinules and interconnectives are thickened: then, the fact that echinules are joined by interconnectives can faintly be seen in ligth microscopy, e.g. in *G. lucidum* from Vietnam.

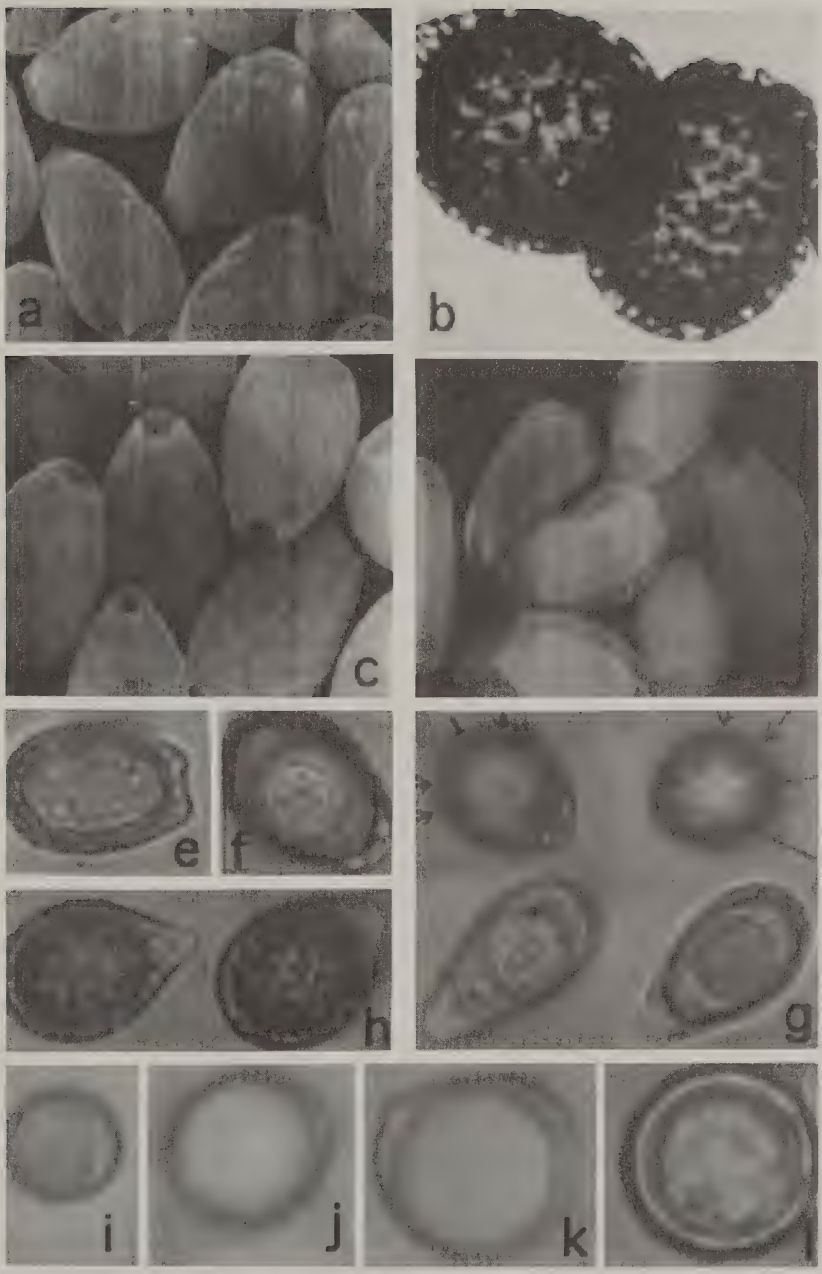
2. Intermediate form: the "ganodermoid/humphreyoid" basidiospore.

One collection from Vietnam showed basidiospores with a labyrinthe-reticulate architecture (Fig. 1h) because of the thickening of some interconnectives between echinules. The labyrinthe-reticulate architecture does not appear in scanning electron microscopy (Fig. 1c) because it was covered by the hyaline endosporium. We have identified this collection as *G. trengganuense*, a species described by Corner (1983) from a single collection from Malaysia. In the original description, Corner (1983) described the spore as being "ellipsoid, reticulate with strong meshes."

3. The typical "humphreyoid" basidiospore.

This kind of basidiospore characterizes the genus *Humphreya* Steyaert, and has been observed so far in only four species: *H. eminii, H. lloydii, H. endertii* and *H. coffeatum*. Spores are large to very large, 10 to 35 µm in length, truncated, and ornamented with a reticulate pattern of ridges which developed from the endospo-rium. The ridges are 2 - 3 µm thick. The coverage of the ridges by the hyaline episporium (tectum) usually collapses in dry specimens. The germpore is similar to that of ganodermoid spores (large aperture, Fig. 1c).

Fig. 1. Some types of basidiospores in the Ganodermataceae. a. *G. lucidum* (SEM); b. *G. lucidum* (TEM); c. *G. trengganuense* (SEM); d. *G. pseudoferreum* (SEM); e, f. *G. fulvellum* (LM); g. *G. australe* (LM); h. *G. trengganuense* (LM); i. *A. juxtarugosum* (LM); j. *A. nigrum* (LM); k. *A. macer* (LM); l. *A. elmerianum* (LM).


a
b
c
e
f
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4. The typical "amaurodermoid" basidiospore.

This kind of basidiospore characterizes the genus *Amauroderma* Murrill. Spores are hyaline to pale yellow, subglobose to cylindrical, 4 - 17 µm in diameter or length, bitunicate with the inner wall finely asperulate. The sporoderma is uniformly thickened. Echinules are generally thinner than in the ganodermoid spore, sometimes absent or not seen in some species, then, basidiospores are smooth in ligth microscopy, e.g. *Amauroderma macer*, *A. elmerianum, A. elaensis,* and *A. oblongisporum* (Figs. 1i - l; Fig. 3; Ryvarden and Johansen, 1980).

The germpore is quite distinctive from the ganodermoid and humphreyoid basidiospores (Fig. 2): the aperture is a tiny papilla, difficult to see (0.5 - 1.5 µm in diameter) (Figs. 1i - l). In same case it is so tiny that it is not revealed in ligth microscopy and not drawn, e.g. in *Amauroderma subresinosum* (= *Magoderna subresinosum* Steyaert, Steyaert 1972), *A. argenteofulvum* or *A. kwiluensis* (Ryvarden and Johansen, 1980).

I agree with Furtado (1965) that oblong basidiospores found in some species of *Amauroderma* are not transitive forms between the globose and ovate forms which are typical in the genus; they are also not intermediate forms between typical *Ganoderma* and *Amauroderma* spores because their apertures are extremely diminished and even disappear ("anaperture") in some species. I also agree with Furtado (1965) that basidiospore shape is a reliable character for distinguishing between genera *Ganoderma* and *Amauroderma.*

5. The typical "haddowioid" basidiospore.

This kind of basidiospore characterize the three species of the genus *Haddowia* Steyaert. Spores are ellipsoid, bitunicate, longitudinally costate; coastae are made of two longitudinal crests connected by transverse membranes. The outer hyaline wall is collapsed. The germpore is an "anaperture".

This type of basidiospore is unique to the three *Haddowia* species described to date (*H. longipes, H. aeti* and *H. neurospora*). It is so distinctive from the other basidiospore types found in the Ganodermataceae that Jülich (1981) created the family Haddowiaceae to accomodate the species with this kind of spores.

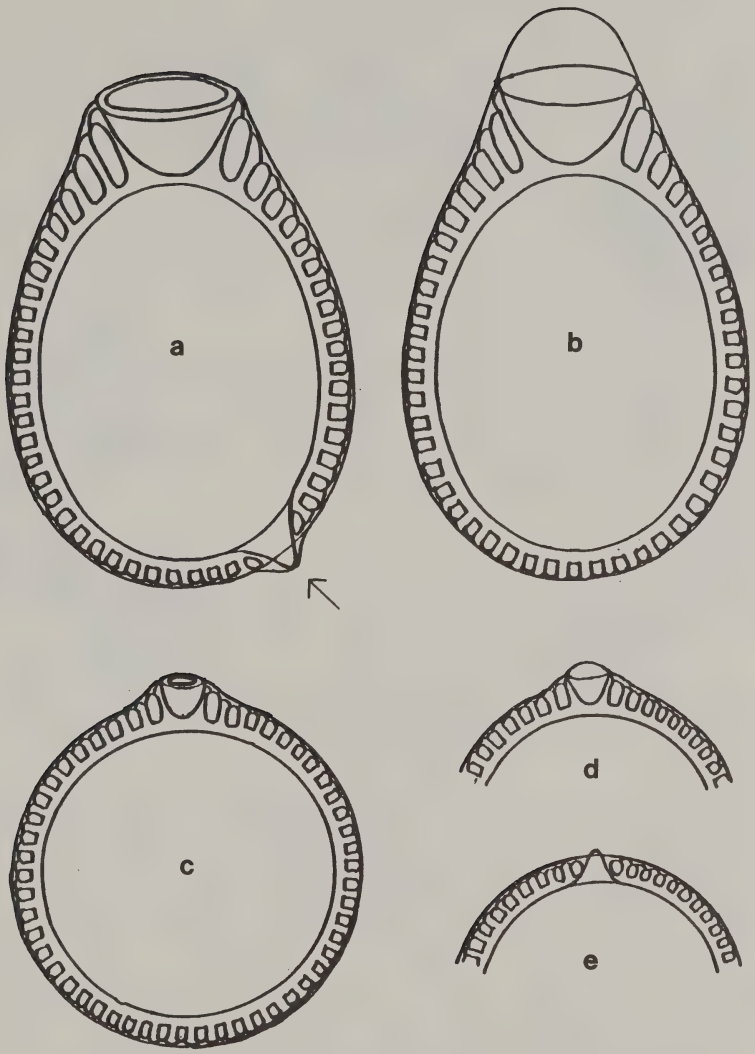


Fig. 2. Schematic types of basidiospores in the Ganodermataceae. a, b: *Ganoderma* Karst. and *Humphreya* Stey.: (a) truncated apex and germpore with large aperture, the arrow indicates the attachment of the spore to the sterigma ("pseudoaperture"); (b) convex apex with the tectum covering the germpore. c, d, e: *Amauroderma* Murr. (including *Magoderna* Stey) and *Haddowia* Stey.: germpore with point aperture.

6. Colpate ganodermoid basidiospores.

Using scanning electron microscopy Pegler and Young (1973) were the first to show the existence of ganodermoid basidiospores with longitudinal cavities (colpate ganodermoid basidiospore). Hseu (1990) and Yeh (1990) showed SEM pictures of colpate basidiopores in collections identified *G. applanatum, G. formosanum* and *G. neojaponicum* from Taiwan. The same structure was observed by Buchanan and Wilkie (1995) from New-Zealand collections identified *G. australe*. I have found similar basidiospores in *G. pseudoferreum, G. australe* and *G."japonicum"* from Vietnam (Figs. 1d, g).

In this type of basidiospore, the endosporium tends to brake where the colpate develop. These colpates are similar with the longitudinal crests of *Haddowia* species. Therefore, I assume that this type of basidiospore is intermediate between ganodermoid and haddowioid basidiospore types.

A phylogenetic hypothesis of the Ganodermataceae based on a possible evolution of the basidiosporoderma.

I follow Ryvarden (1991) and assume that *Ganoderma* is a derived genus in the polypores. I also speculate that *Ganoderma* is the genus from which other genera of Ganodermataceae have derived.

My observations showed that the typical ganodermoid basidiospore has a large aperture with a convex cap (tectum) which can easily break down in many species, then the apex appear slightly concave or truncate. It seems natural to propose that differentiation of the typical amaurodermoid from typical ganodermoid spore occured by reduction of the germpore (aperture) into point aperture or anaperture, and in changing the ovate (or truncated) forms into subglobose/globose. The sister relationships between *Ganoderma* and *Amauroderma* was suggested by Furtado (1965), Steyaert (1972), Ryvarden and Johansen (1980), and more recently from molecular evidence by Moncalvo *et al.* (1995, 1997).

The humphreyoid spore morphology seems to derive from the ganodermoid spore morphology by the development of a reticulate structure by enlargement of the connective between echinules. This is strongly suggested from the existence of an intermediate form: the imperfectly reticulate spore (referred above

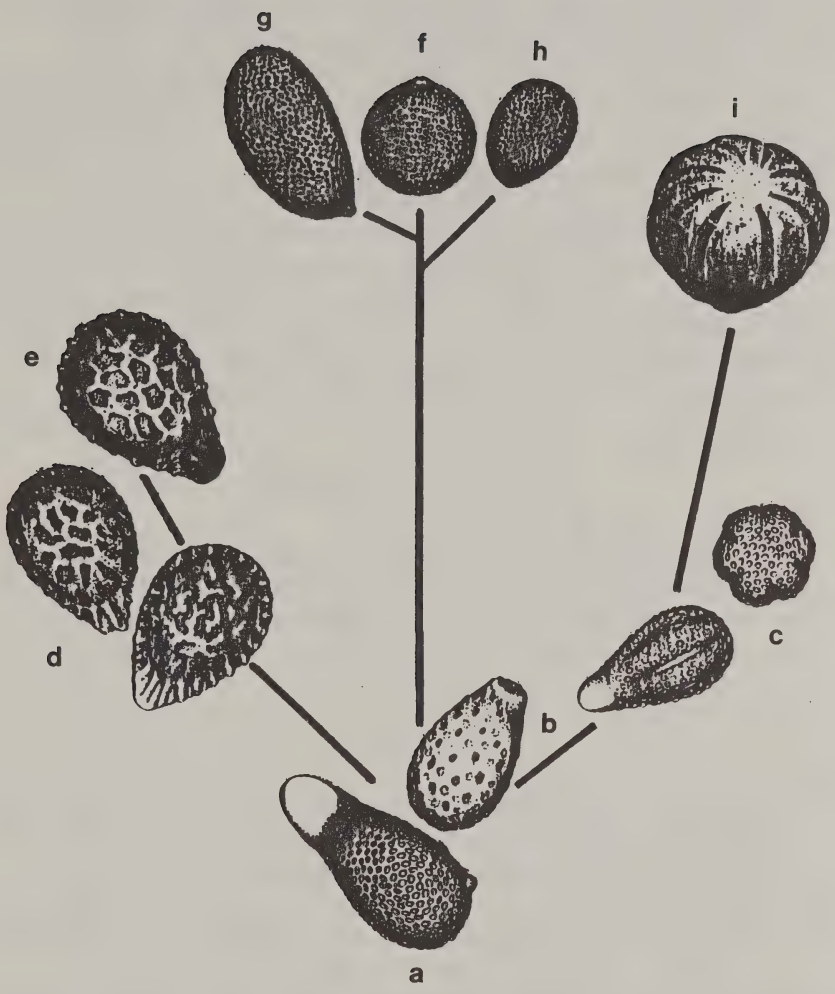


Fig. 3. A phylogenetic hypothesis of the Ganodermataceae based on a possible mode of evolution of the basidiosporoderma. a-d: *Ganoderma* (a. *G. tornatum*, b. *G. lucidum*, c. *G. pseudoferreum*, d. *G. trengganuense*); e: *Humphreya eminii*; f-h: *Amauroderma* (f. *A. macer*, g. *A. oblongisporum*, h. *A. subresinosum* = *Magoderna subresinosum*; i: *Haddowia longipes*). e, g, i, redrawn from Ryvarden and Johansen, 1980.

as labyrinthe-reticulate) observed in *G. trengganuense* from Vietnam (Tham and Nhan, 1995; Tham 1996).

The haddowiod spore morphology may have been derived from colpate ganodermoid spores by an extraordinary development of the colpate structure into a deeply coasted structure, accompagnied by breakage of the endosporium and reduction of the aperture into anaperture.

In relationships to basidiospore evolution (Fig. 3), the Ganodermataceae would then naturally circumscribe into four genera: *Ganoderma* Karsten, *Humphreya* Steyaert, *Amauroderma* Murrill, and *Haddowia* Steyaert. I consider *Magoderna* Steyaert a synonym of *Amauroderma* and *Tomophagus* Murrill a synonym of *Ganoderma*, with *Ganoderma* being the most primitive genus.

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ANNOTATED CHECKLIST OF NEW CALEDONIAN BASIDIOMYCOTA. II. RUSTS AND SMUTS.

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ABSTRACT:

An annotated check-list of plant pathogenic basidiomycetes collected mainly in New Caledonia is presented, supplemented by a few similar records from French Polynesia. The list is basically prepared from specimens present in the neocaledonian herbarium. Specimen annotations were checked with available literature. Few specimens proved not to be reported in any publication.

Over 70 taxa are recorded from the main island and its dependancies; records from other South Pacific French islands being of the casual type. This figure is meaningless when the rich vascular flora of New Caledonia, made up of mainly endemic taxa with several primitive genera, is considered.

Taxa are listed alphabetically by genus and species with descriptive, bibliographic and collecting information in addition to herbarium references. Twenty six genera are represented, with only four relating to smut fungi. *Puccinia* and *Uromyces* make up more than half of total species. For *Ustilago, Graphiola*, *Sphacelotheca* and *Uredo,* only two species are recorded for each; most genera are thus represented by only one taxon.

Aecidium balansae, Dicheirina vienottii, Graphiola cocoina, Mapea radiata, Puccinia lifuensis, P. montisfontium, P. thiensis, Ravenelia neocaledoniensis and *Sporisorium caledonicum* have protologues based on material collected in the main island; the latter taxon has apparently not been reported since. These novelties and the remaining taxa proved to be little documented with respect to their distribution and host-plant relationships. Infested plant material is mostly of taxa of economic importance.

This list will enable specialists of these obligate fungi to study representatives associated with the endemic plants of New Caledonia.

KEY WORDS: fungi, basidiomycetes, biodiversity, rust fungi, smut fungi, New Caledonia, South Pacific, list and taxonomic status.

INTRODUCTION

The oldest report on rusts and smuts of New Caledonia can be traced back to the first contribution on fungi of this island published by Patouillard (1887). *Aecidium balansae,* proposed as a new taxon, was to remain the only rust recorded for almost a century. Patouillard also described *Sorosporium caledonicum* (now *Sporisorium caledonicum*), a smut fungus apparently not collected since. No other report on smut fungi was included in subsequent papers by Patouillard.

However, Patouillard (1906) proposed the new rust genus *Mapea,* type species *M. radiata,* based on material collected in French Polynesia. The genus is still unispecific and its type species is yet undocumented with regard to correct taxonomic position. Patouillard (1904) established the new smut genus *Graphiola,* type species *G. cocoina,* on infected coconut material originating from these islands. Cole (1983) proposed the new order Graphiolales for this interesting fungus.

Marked interest in plant pathogenic fungi of New Caledonia started after World War II. This related to the nomination of the phytopathologist F. Bugnicourt as Assistant-Director of the new Institut Français d'Océanie, now Centre ORSTOM de Nouméa (Mouchacca, 1997). Few collections of rusts, and even fewer smuts, had been made in the South Pacific region until that time. Such was accomplished by Bugnicourt and subsequent resident phytopathologists in relation to plants of economic importance (Bugnicourt & Marty, 1961). Contributions on neocaledonian rusts are due to Huguenin [1966, (1967) 1968]. This author extensively collected fungi in the area starting from 1964 and his material represents the core of the neocaledonian herbarium. Huguenin reported on 54 rusts with five being new to science. Since then, no additional information on these fungi has been published. This situation is less drastic, however, when compared to the smuts of this island for which not a single paper has ever been produced.

Some phytopathogenic basidiomycetes are reported in the first list of parasitic fungi on cultivated plants in New Caledonia (Bugnicourt and Marty, 1961). These have also been included in subsequent versions expanded to cover other French islands of the South Pacific (Kohler & Pellegrin, 1992). Similar surveys have also been recently prepared for other states and islands of the region. McKenzie and Jackson (1986) reported on fungi, bacteria and pathogenic algae of Solomon Islands; they also treated the same groups for the Republic of Palau (McKenzie and Jackson, 1990a) and for the Federated States of Micronesia (McKenzie and Jackson, 1990b). Further, McKenzie (1989) listed fungi, bacteria and pathogenic algae of Vanuatu (former New Hebrides) and later for American Samoa (McKenzie, 1996). A compilation of fungi and bacteria observed on plants in the Marshall Islands was issued by McKenzie and Jackson (1996).

Some attempts have been made on a regional scale to bring together information on taxa of economic importance, including rusts and smuts. An annotated bibliography on sources of information on plant disease distribution in the area of the South Pacific Commission was published by Firman (1975); it includes the earlier relevant list of recorded plant diseases (Dumbleton, 1954). This document was later expanded to titles relating to mycology (Firman, 1978a). The main problems of plant pathology concerning state members of this Commision were also reviewed by Firman (1978 b). Records of fungi, bacteria and algae pathogenic on plants were partially synthesized by Dingley *et al.* (1981).

Information for the present contribution on phytopathogenic basidiomycetes, mainly collected in New Caledonia was drawn from relevant material present in the small neocaledonian herbarium lodged in PC (Mouchacca, 1990). It is the third of a series of papers dealing with new records of ascomycetes (Mouchacca, 1998) and basidiomycetous taxa (Horak & Mouchacca, in press). The reported information on rusts and smuts is, however, of little value when compared with the well studied, rich vegetation of this tropical island. The main character of the flora is a high degree of endemism and the presence of several primitive plant genera (Hallé, 1977). This would suggest that highly interesting plant-fungus associations await to be discovered.

ENUMERATION OF PLANT PATHOGENIC BASIDIOMYCETES

Herbaria:	FH	Farlow Herbarium, Cambridge, MASS, USA
	IFO	Institut Français d'Océanie, Nouméa
	K	Royal Botanic Gardens, Kew, UK
	PC	Paris Herbarium, Paris, France (located in MNHN)
	MNHN	Muséum National d'Histoire Naturelle, Paris, France
Localities:	LI	Loyalty Islands (Iles Loyauté)
	NC	New Caledonia (Nouvelle Calédonie)
	PF	Polynésie Française
	PS	Pacifique Sud

* indicates new taxon described from New Caledonia
! indicates material has been examined by the authors
ital. indicates current taxonomic position of species

For each taxon treated, full reference of the original binomial is indicated if still valid. Alternatively the latest taxonomically accepted binomial is then fully referenced. For names published before 1920, the volume (s) of Saccardo's *Sylloge Fungorum* where the binomial is cited is specified under the heading literature. These are indicated in Roman characters whenever the corresponding binomial could be traced in this series following the relevant general index authored by Reed and Farr (1993). References to post-description citations of any taxon then follow. Information about original date and place of collection, host or substrate and the collector are also specified. When several collections were cited, the same information is reproduced for each. Finally, refuted generic transfers are sometimes underlined and occasionally a synonym is also specified.

Citation of author's names follows Kirk & Ansell (1992). Pfister's (1977) annotated index to fungi described by Patouillard was consulted for material present at Farlow Herbarium.

⇒***Aecidium balansae**** Cornu ex Pat. 1887. Bull. Soc. Mycol. Fr. 3: 173.
Lit.: VII: 825; XII: 7; XIX: 18; XXIII: 889; Huguenin 1966: 250.
NC: On leaves of '*Dammara ovata*' (Araucariaceae), leg. Balansa 3692 (holotype, PC). Recent collections from NC: Col d'Amieu (Pépinière Eaux et Forêts), on *Agathis moorei* (Araucariaceae), 4 III 1960, leg. Marty, det. Viennot-Bourgin NC 60-101 (PC); Monts Koghis, same host, 4 V 1964, leg. & det. Huguenin NC 64-254 (PC); Col d'Amieu, same host, 4 VI 1964, leg. & det. Huguenin NC 64-261 (PC); La Crouen, same host, 8 VI 1967, leg. & det. Huguenin NC 67-096 (PC); Vallée de l'Ouinné, on *Agathis ovata* (Araucariaceae), 1 X 1963, leg. & det. Huguenin NC 63-185 (PC); Montagne des Sources, same host, 31 VIII 1964, leg. & det. Huguenin NC 64-389

(PC); Plaine des Lacs, same host, 20 II 1967, leg. & det. Huguenin NC 67-015 (PC); material collected by Huguenin was erroneously identified by him as *Aecidium fragiforme* Ces.

The type material in PC bears the following handwritten notes on the printed label: Herb. Mus. Paris: "*Aecidium balansae* Cornu, sp. nov. (Patouillard !), rameaux de *Dammara ovata,* Mont Peuari, vers 700 m d'altitude, février 1872, Balansa 3692". Just a few years after its description, Saccardo 1891(IX: 326) listed this rust as "*Peridium balansae* Cornu in Pat.". The page number of the original reference as given by Saccardo (p. 6) corresponds in fact to the one on the distributed, repaginated reprints; further t. 17 relates to tab. 17 and not to tome 17 of the Bulletin issued in 1901.

In 1906, Maire identified a second species, *viz. Peridermium balansae,* also developing on *Dammara (Agathis) moorei* (leg. Franc) in NC. However, in 1924, P. & H. Sydow rejected Saccardo's transfer of *Aecidium balansae* to *Peridermium* Lév. This rust fungus remained apparently overlooked until the arrival of Huguenin in New Caledonia. Then fresh collections have been made from *Agathis moorei* at Col d'Amieu and Monts Koghis and on *A. ovata* in the Vallée de l'Ouinné and in the Montagnes des Sources (Huguenin 1966). However, this author regards *Aecidium balansae* as being identical to the previously described *A. fragiforme* Ces.

Punithalingam & Jones (1971) examined a large collection of *Aecidium* spp. on *Agathis* (including authentic material of *Aecidium balansae* and *A. fragiforme*) from several tropical regions including NC. They disclosed evidence supporting distinctiveness of both taxa: aeciospore walls of *Aecidium balansae* have coarsely warted surface ornementation while those of *A. fragiforme* have a definite spiny surface. This conclusion thus substantiates similar views expressed earlier and summarized by P. & H. Sydow (1924). Only *Aecidium balansae* was then regarded as being present in NC.

Taxa of *Aecdium* Pers. represent anamorphic Uredinales of (0) and (1) stages only whose life history is not fully elucidated. No general account encompassing the almost 600 proposed names is available (Hawksworth *et al.*, 1995).

⇒***Cerotelium fici*** (Butler) Arth. 1917. Bull. Torrey Bot. Cl. 44: 509.
Bas.: *Kuehneola fici* Butler 1914. Ann. Mycol. 12: 79 (76-79).
= *Physopella fici* (Cast.) Arthur 1906. Résult. Sc. Congr. Int. Bot. Vienne: 338; *nom. illeg., fide* Laundon & Rainbow, 1971.
Bas.: *Uredo fici* Cast. in Desm. 1848. Plant. Crypt., no. 1662 ; Supplem. Cat. plant. Mars. II: 87. 1851; *fide* Jorstad, 1958.
Lit.: VII: 847 (as *U. fici* Cast.); XXII: 790 [as *K. fici* (Cast.) Butler]; Patouillard 1906: 46; Huguenin 1966: 252.
NC: Mont Dore, Nouméa, on *Ficus carica* (Moraceae), 24 X 1960, leg. & det. Marty NC 60-140 (PC); Hienghène, on *Ficus* sp. (Moraceae), 3 X 1963, leg. & det. Huguenin NC 63-220 (PC). - PF: Iles Gambier, Rikitea, on leaves of *Ficus carica* (Moraceae), leg. Seurat (no specimen in PC).

⇒***Cintractia peribebuyensis*** (Speg.) Sawada 1919. Agr . Exp. Sta. (Formosa), Sp. Bull. 19 : 363.
Bas.: *Ustilago peribebuyensis* Speg. 1884. Anales Soc. Ci. Argent. 17: 89.
PF : Punaouia, Tahiti, on *Cyperus odoratus* (= *Torulinium ferax)* (Cyperaceae), 27 III 1966, leg. Huguenin, PF 66-088 (PC).

The above specimen was simply labelled *Ustilago* sp. It was reidentified by K. Vánky.

⇒***Coleosporium elephantopodis*** Thüm. 1878. Myc. Univ. No. 953.
Lit.: VII: 753 (as *C. elephantopodis*); Huguenin 1966: 252.

NC: La Crouen, on *Elephantopus mollis* (Asteraceae), 13 VII 1964, leg. & det. Huguenin NC 64-227 (PC); same locality and host, 1 VI 1967, leg. & det. Huguenin NC 67-097 (PC); Tü, Houaïlou, same host, 22 VII 1964, leg. & det. Huguenin NC 64-320 (PC); Doneva, same host, 15 VI 1965, leg. & det. Huguenin NC 65-071 (PC); Col d'Amieu, same host, 20 IV 1967, leg. & det. Huguenin NC 67-052 (PC).

Coleosporium elephantopodis is sometimes considered as a later name for *C. vernoniae* Berk. & Cooke (Grevillea 3: 57. 1874). However the former is more commonly used for the rust developing on *Elephantopus spp.* and the latter for *Vernonia spp.* But according to Cummins (1978: 375) the two taxa "are separable only by the hosts".

⇒***Dasturella divina*** (Syd.) Mundkur & Kheswalla 1943. Mycologia 35: 203.
Bas.: *Angiopsora divina* Sydow 1936. Ann. Mycol. 34: 69.
Lit.: Huguenin 1966: 252.
NC: Houaïlou, on *Bambusa* sp. (Poaceae), 30 IX 1963, leg. & det. Huguenin NC 63-115 (PC); Pouembout, *Bambusa vulgaris* (Poaceae), 21 X 1964, leg. & det. Huguenin NC 64-501 (PC).

⇒***Dicheirinia vienottii**** B. Huguenin 1966. Bull. Soc. Mycol. Fr. 82: 255.
NC: Nouméa, Monts Koghis, on living leaves of *Albizzia granulosa* (Caesalpiniaceae), 19 IV 1965, leg. Huguenin 65-051 (holotype, PC); Mont Mou, same host, 26 VIII 1966, leg. & det. Huguenin NC 66-048 (PC).

This new species of *Dicheirinia* Arthur was dedicated to the French phytopathologist G. Viennot-Bourgin who contributed much towards our present knowledge of rusts and smuts. No modern account of this tropical genus is available (Hawksworth *et al.*, 1995).

⇒***Endophyllum kaernbachii*** (P. Henn.) Stevens & Manidola 1931. Phillipp. Agric. 20 : 7.
(*Aecidium* stage: *Aecidium kaernbachii* P. Henn. 1892. Engl. bot. Jahrb. 15: 5).
Lit. : XVI: 343.
PS : Wallis, Mata Ata, on *Ipomoea pes-caprae* (Convolvulaceae), 1 VII 1964, leg. Barrau, det. Huguenin, PS 64-352 (PC).

⇒***Goplana dioscoreae*** Cumm. 1960. Bull. Torrey Bot. Club 83: 35.
Lit.: VII: 828 (as *A. discoreae*); Huguenin 1966: 255.
NC: Nouméa, Forêt de Thi, *Dioscorea bulbifera* (Dioscoreaceae), 3 V 1964, leg. & det. Huguenin NC 64-266 (PC). - LI: Lifou, same host, 14 IV 1964, leg. & det. Huguenin NC 64-055 (PC); same locality, same host, 15 IV 1967, leg. & det. Huguenin NC 67-057 (PC). - PS: Vanuatu, Tongariki, same host, 10 XI 1963, leg. & det. Huguenin PS 63-193 (PC); Vanuatu, Rannon-Ambrym, 5 II 1964, leg. & det. Huguenin PS 64-033 (PC).

The earlier combination *Goplana dioscoreae* (Berk. & Broome) Cummins (Mycologia 27: 605. 1935) is invalid being based on *Aecidium discoreae* Berk. & Broome (Jour. Linn. Soc. Bot. 14: 95. 1875).

⇒***Graphiola cocoina**** Pat. 1904. Bull. Soc. Mycol. Fr. 20: 137.
Lit.: XVII: 493.
PF: Iles Gambier, Mangareva, on living leaves of *Cocos nucifera* (Palmae), leg. Seurat 18 (holotype, FH; isotype, PC). Beside the Farlow specimen, a second collection is kept in PC, bearing the following hand writings: *Graphiola cocoina*, feuilles de *Cocos nucifera*, Mangareva (Gambier), leg. Seurat, Pat. !).
Recent collections: LI: Lifou, same host, 5 XII 1958, leg. & det. Bugnicourt NC 58-078 (PC). - PF: Tahiti, Raiatea, same host, 14 IX 1963, leg. & det. Huguenin & Marty, PS 62-239 (PC); Iles Gambier, Mangareva, Ganoa, same host, 21 IV 1966, leg. & det.

Huguenin PS 66-077 (PC). - PS: Vanuatu, Tanna, same host, 12 II 1959, leg. & det. Marty PS 59-010 (PC); Fiji, same host, 6 I 1961, leg. & det. Marty PS 61-152 (PC).

Recently, Cole (1983) disentangled the taxonomic confusion that persisted for about 160 years concerning the type species of *Graphiola* Poit., *G. phoenicis* (Moug.) Poit. This biotrophic parasitic fungus occurring on palms proved to be a member of the Heterobasidiomycetes and accordingly is better accommodated in the separate order Graphiolales. Cole's interesting paper was unfortunately not followed by a revision of the taxonomic status of taxa referred to that genus.

⇒***Graphiola phoenicis*** Poit. 1824. Ann. Sci. Nat. Bot., sér. 1a, 3: 473.
Lit.: Patouillard 1887: 173.
NC: Locality and collector unknown, common on leaves of palms (PC); Dumbéa, on *Phoenix* sp. (Palmae), 1 VIII 1959, leg. & det. Bugnicourt NC 59-042 (PC).

⇒***Hamaspora acutissima*** H. & P. Sydow 1912. Monographia Uredinearum III: 80, Tab. IV, Fig. 41.
Lit. : XXIII: 818.
NC: Tipindje, on *Rubus roseafolius* (Rosaceae), 1 X 1963, leg. & det. Huguenin, NC 63-171 (PC).

⇒***Hemileia vastatrix*** Berk. & Broome 1869. Gard. Chron. 6: 1157.
Lit.: VII: 585; Huguenin 1966: 255.
NC: Voh, on *Coffea arabica* (Rubiaceae), 6 VIII 1959, leg. & det. Bugnicourt NC 59-044 (PC); Vallée de la Tchamba, same host, 16 V 1962, leg. & det. Huguenin NC 62-179 (PC); Gwereu, Houaïlou, same host, 21 VII 1964, leg. & det. Huguenin NC 64-334 (PC). - PS: Vanuatu, Station de Tagabe, Efate, same host, 23 VII 1962, leg. & det. Huguenin PS 62-186 (PC).

⇒***Mapea radiata**** Pat. 1906. Bull. Soc. Mycol. Fr. 22: 46.
Lit.: XXI: 814.
PF: Iles Gambier, Rikitea, on fruits of *Inocarpus edulis* (Fabaceae), leg. Seurat 608 (holotype, FH); same locality, Rorutu, on fruits of *Inocarpus edulis,* leg. Seurat (no number, isotype, PC).

This is the type species of *Mapea* Pat. (1906). Maire (1913) re-examined authentic material preserved in alcohol and his conclusion favours maintenance of *Mapea* Pat. in the Uredinales. This rust fungus has apparently not been observed since its description although it was then extensively collected by the original collector Seurat (*fide* Maire, 1913). *Mapea* Pat. was, however, not accepted as a distinct genus by Cummins (1959: 123) who regarded this as a synonym of *Uredo* Pers.:Pers. Also Laundon (1967) described a new genus *Telomapea* with *T. inocarpi* (Racib.) Laundon as type species (Bas.: *Uromyces inocarpi* Racib.). *Mapea radiata* is the uredinial state of *Telomapea inocarpi*. However Cummins & Hiratsuka (1983) regard *Telomapea* as a later name of *Maravalia* Arthur.

Regarding *Mapea* Boedijn (Hawksworth *et al.*, 1995), Laundon (1967) stress 'Boedijn was the first to describe telia but he did not use Latin and he did not propose a new generic name'.

⇒***Masseeeila breyniae*** Thirum. 1943. New Phytol. 42: 47.
(*Aecidium* stage: *A. breyniae* Sydow 1907. Ann. Mycol. 5: 506).
Lit.: XXI: 780 (as *A. breyniae*); Huguenin 1966: 256.
NC: Bacouya, Bourail, on *Breynia disticha* var. *disticha* f. *nivosa* (Euphorbiaceae), 24 VII 1964, leg. & det. Huguenin NC 64-348 (PC); only the *Aecidium* stage was observed (PC). - LI: Lifou, same host, 15 IV 1967, leg. & det. Huguenin NC 67-059 (PC).

⇒***Phakopsora gossypii*** (Lagerh.) Hiratsuka 1955. Ured. Stud.: 266.

Bas.: *Doassanssia gossypii* Lagerh. 1891. J. Mycol. 7: 49.
Lit.: XI: 235 (as *D. gossypii);* Huguenin 1966: 256.
NC: Tü, Houaïlou, on *Gossypium* sp. (Bombacaceae), 22 VII 1964, leg. & det. Huguenin NC 64-340 (PC). - LI: Lifou, Deuleu, same host, leg. & det. Huguenin 5 XI 1964, NC 64-520 (PC).

⇒***Phakopsora pachyrhizi*** H. & P. Sydow 1914. Ann. Mycol. 12: 108.
Lit.: XXIII: 323; Huguenin 1966: 256.
NC: Tü, Houaïlou, on *Erythrina* sp., 22 VII 1964, leg. & det. Huguenin NC 64-321 (PC); same locality, on *Mucuna urens* (Papilionaceae), 22 VII 1964, leg. & det. Huguenin NC 64-353 (lost).

⇒***Puccinia*** sp. 1.
NC : Nassadiou, Bourail, on *Fimbristylis ferruginea* (Cyperaceae), 1 VIII 1967, leg. & det. Huguenin, NC 67-100 (PC).

⇒***Puccinia*** sp. 2.
PF : Iles Gambier, Mangareva, Rikitea, on *Cyperus odoratus* (= *Torulinium ferax*) (Cyperaceae), 1 IV 1966, leg. & det. Huguenin, PS 66-074 (PC).

⇒***Puccinia antirrhini*** Dietel & Holw. 1897. Hedwigia 36: 298.
Lit.: XIV: 353; Huguenin 1966: 256.
NC: Nouméa, on *Antirrhinum majus* (Scophulariaceae), 18 X 1965, leg. & det. Huguenin NC 65-070 (PC); Nouméa, same host, 21 IX 1966, leg. & det. Huguenin NC 66-147 (PC).

⇒***Puccinia cannae*** P. Henn. 1902. Hedwigia 41: 105.
Lit.: XVII: 366.
NC: Tiwaka, on *Canna indica* (Cannaceae), 19 VII 1961, leg. Huguenin, det. Viennot-Bourgin, NC 61-165 (PC).

⇒**Puccinia cenchri** Diet. & Holw. 1897. Bot. Gaz. 24: 28.
Lit.: XIV: 353; Huguenin 1966: 256.
NC: IFO, Nouméa, on *Cenchrus echinatus* (Poaceae), 22 VIII 1963, leg. & det. Huguenin NC 63-120 (PC).

⇒***Puccinia coronota*** Corda 1837. Icon. Fung. 1: 6.
Lit.: VII: 623, 698; Huguenin 1966: 256.
NC: Nouméa, Pont des Français, on *Avena sativa* (Poaceae), 18 IX 1964, leg. & det. Huguenin NC 64-461 (PC); Nouméa, Centre Agronomique, Port-Laguerre, same host, 16 XI 1964, leg. & det. Huguenin NC 64-529 (PC).

⇒***Puccinia crepidis-japonicae*** Dietel 1908. Ann. Mycol. 6: 226.
Uredinial state: *Uredo crepidis-japonicae* Lindroth 1902. Acta Soc. Fauna Flora fenn. 22: 11.
Lit.: XVII: 438 (as *U. crepidis-japonicae*); XXI: 652 (as *P. crepidis-japonicae*); Huguenin (1967) 1968: 941.
NC: Tribu du Grand Couli, La Foa, on *Crepis japonica* (Asteraceae), 27 VIII 1966, leg. & det. Huguenin NC 66-053 (PC).

⇒***Puccinia cynodontis*** Lacroix: Desm. 1859. Pl. Crypt. III: 655.
Lit.: VII: 661; Huguenin 1966: 258.
NC: Nouméa, IFO, on *Cynodon dactylon* (Poaceae), 20 VII 1963, leg. & det. Huguenin NC 63-111 (PC).

⇒***Puccinia duthiae*** Ell. & Tracy 1897. Bull. Torrey Bot. Cl. 24: 283.
Lit.: XIV: 352; Huguenin 1966: 258.

NC: Nouméa, IFO, on *Bothriochloa pertusa* (Poaceae), 23 IX.1964, leg. & det. Huguenin NC 64-465 (PC); Nouméa, Ouen-Toro, same host, 25 IX 1964, leg. & det. Huguenin NC 64-487 (PC).

⇒***Puccinia engleriana*** P. Henn 1904. Engl. bot. Jahrb. 34: 40.
Lit.: XVII: 336.
PS: Vanuatu, Tongariki, on *Tabernaemontana orientalis* (Apocynaceae), 11 XI 1963, leg. & det. Huguenin, PS 63-189; Vanuatu, Aoba Walaha, same host, 7 II 1964, leg. & det. Huguenin, PS 64-007 (PC).

⇒***Puccinia erythropus*** Dietel 1905. Engler's Bot. Jahrb. 37: 101.
Lit.: XX: 580; Huguenin (1967) 1968: 942.
NC: Païta, base du Mont Mou, on *Miscanthus japonicus* (Poaceae), 30 XI 1965, leg. Huguenin NC 65-040 (PC); Nouméa, Forêt de Thi, same host 5 III 1967, leg. & det. Huguenin NC 67-031 (PC). - PF: Iles Gambier, Mangareva, same host, 1 IV 1966, leg. & det. Huguenin PS 66-085 (PC).

⇒***Puccinia graminis*** Pers.: Pers. 1801. Syn. Meth. Fung.: 228.
Lit.: VII: 622; Huguenin 1966: 258.
NC: Pouembout, on *Triticum vulgare* (Poaceae), 22 X 1964, leg. & det. Huguenin NC 64-491 (PC); Ouaco, same host, 23 X 1964, leg. & det. Huguenin NC 64-497 (PC); Nouméa, Centre Agronomique, Port-Laguerre, same host, 16 XI 1964, leg. & det. Huguenin NC 64-530 (PC); same locality, on *Avena sativa* (Poaceae), 16 XI 1964, leg. & det. Huguenin NC 64-528 (PC); same locality and host, 30 XI 1965, leg. & det. Huguenin NC 65-097 (PC).

⇒***Puccinia kraussiana*** Cooke 1882. Grevillea 10: 126.
Lit.: VII: 657; Huguenin (1967) 1968: 942.
NC: Plaine des Lacs, on *Smilax ligustrifolia* (Smilacaceae), 6 X 1966, leg. & det. Huguenin NC 66-129 (PC); Montagne des Sources, Nouméa, same host, 1 I 1968, leg. & det. Huguenin NC 68-001 (PC); same locality, on *Smilax neocaledonica* (Smilacaceae), 16 IX 1966, leg. & det. Huguenin NC 66-104 (PC); Plaine des Lacs, same host, 27 X 1966, leg. & det. Huguenin NC 66-171 (PC); same locality and host, 6 III 1967, leg. & det. Huguenin NC 67-079 (PC); Montagne des Sources, on *Smilax plurifurcata* (Smilacaceae), 5 X 1966, leg. & det. Huguenin NC 66-133 (PC); Nouméa, Forêt de Thi, same host, 14 X 1961, leg. & det. Huguenin NC 61-173 [PC: formerly reported as *Puccinia henryana* Syd., Huguenin, (1967) 1968]; same locality and host, 4 I 1964, leg. & det. NC 64-059 [PC: formerly reported as *Puccinia henryana* Syd., Huguenin, (1967) 1968]; same locality and host, 8 III 1967, leg Huguenin NC 67-080 (PC); La Crouen, same host, 21 VI 1964, leg. & det. Huguenin NC 64-259 [PC: formerly reported as *Puccinia henryana* Syd., Huguenin, (1967) 1968].
LI: Lifou, on *Smilax plurifurcata* (Smilacaceae), 4 XI 1964, leg. & det. Huguenin NC 64-518 [lost: formerly reported as *Puccinia henryana* Syd., Huguenin (1967) 1968]; Lifou, Ile Maré, on *Smilax orbiculata* (Smilacaceae), 6 V 1966, leg. Botton, det. Huguenin NC 66-017 (PC).

⇒***Puccinia kuehnii*** Butler 1914. Ann. Mycol. 12: 82.
Uredinial state: *Uromyces kuehnii* W. Krüger 1890. Bericht. D. Vers.- Anst. Zuckerrohr in West-Java, Kajok-Tegal, Dresden 1:117.
Lit.: XI: 182 (as *U. kuehnii*); XXIII: 744 (as *P. kuehnii*); Huguenin 1966: 260.
NC: Nouméa, IFO, on *Saccharum officinarum* (Poaceae), 29 X 1959, leg. & det. Bugnicourt NC 59-055 (PC).

⇒***Puccinia levis*** (Sacc. & Bizz.) Magnus var. ***panici-sanguinalis*** (Rangel) Ram. & Cumm. 1965. Mycopath. Mycol. Appl. 25: 44.

Lit.: Huguenin 1966: 260.
NC: Nouméa, IFO, on *Digitaria adscendens* (Poaceae), 16 VIII 1963, leg. & det. Huguenin NC 63-169 (PC); Nouméa, IFO, same host, 13 II 1964, leg. & det. Huguenin NC 64-058 (PC); La Crouen, on *Digitaria sanguinalis* (Poaceae), 11 VII 1964, leg. & det. Huguenin NC 64-272 (PC).

⇒***Puccinia levis*** (Sacc. & Bizz.) Magnus var. ***tricholaenae*** (Sydow) Ram. & Cumm. 1965. Mycopath. Mycol. Appl. 25: 44.
Lit.: Huguenin 1966: 260.
NC: La Crouen, on *Rhynchelytrum repens* (Poaceae), 11 VII 1964, leg. & det. Huguenin NC 64-271 (PC); Nouméa, Ouen-Toro, same host, 25 IX 1964, leg. & det. Huguenin NC 64-490 (PC); La Foa, same host, 7 VIII 1966, leg. & det. Huguenin NC 66-051 (PC); Col d'Amieu, same host, 20 IV 1967, leg. & det. Huguenin NC 67-110 (PC).

⇒***Puccinia lifuensis**** B. Huguenin (1967) 1968. Bull. Soc. Mycol. Fr. 83: 945.
LI: Lifou, on leaves of *Smilax purpurata* (Smilacaceae), 5 XI 1964, leg. Huguenin 64-518 (holotype, PC); same locality and host, 15 IV 1967, leg.Huguenin, NC 67-060 (PC).

⇒***Puccinia montisfontium**** B. Huguenin (1967) 1968. Bull. Soc. Mycol. Fr. 83: 948.
NC: Nouméa, Montagnes des Sources, on living leaves of *Smilax purpurata* (Smilacaceae), 5 X 1966, leg. Huguenin, 66-133 (holotype, PC).

⇒***Puccinia nakanishikii*** Dietel 1905. Engler's bot. Jahrb. 34: 585.
Lit.: XX: 606; Huguenin 1966: 260.
NC: Nouméa, IFO, on *Cymbopogon nardus* (Poaceae), 24 VIII 1959, leg. & det. Bugnicourt NC 59-048 (PC); same locality and host, 30 X 1964, leg. & det. Huguenin NC 64-514 (PC).

⇒***Puccinia paspalina*** Cumm. 1945. Bull. Torrey Bot. Cl. 72: 211.
Lit.: Huguenin 1966: 260.
NC: Nouméa, IFO, on *Paspalum orbiculare* (Poaceae), 23 X 1964, leg. & det. Huguenin NC 64-464 (PC); Dumbéa, on *Paspalum paniculatum* L., 26 VIII 1966, leg. & det. Huguenin NC 66-045 (PC).

⇒***Puccinia paullula*** Sydow 1913. Phillipp. Journal Science, Bot. 8: 195.
Lit.: XXIII: 669; Huguenin 1966: 262.
NC: Bacouya, Bourail, on *Monstera deliciosa* (Araceae), 24 VII 1964, leg. & det. Huguenin NC 64-349 (PC); Nouméa, same host, 16 X 1964, leg. & det. Huguenin NC 64-480 (PC); Nouméa, IFO, same host, 6 X 1964, leg. & det. Huguenin NC 64-483 (PC); same locality and host, 15 XI 1965, leg. & det. Huguenin NC 65-078 (PC).

⇒***Puccinia pelargonii-zonalis*** Doidge 1927. Bothalia 2: 98.
Lit.: Huguenin 1966: 262.
NC: Nouméa, IFO, on *Pelargonium zonale* (Geraniaceae), 11 X 1961, leg. & det. Huguenin NC 61-171 (PC). - PF: Tahiti, same host, 19 X 1966, leg. Millaud, det. Huguenin PS 66-154 (PC).

On Bothalia volume 2, the year of publication is indicated 1926, but Doidge herself used instead 1927 in several later publications (Gjaerum, pers. comm.).

⇒***Puccinia polysora*** Underw. 1897. Bull. Torrey Bot. Cl. 24: 86.
Lit.: XIV: 347; Huguenin 1966: 262.
NC: Pouembout, on *Zea mays* (Poaceae), 5 V 1959, leg. & det. Bugnicourt NC 59-019 (PC); same locality and host, 10 IX 1960, leg. & det. Huguenin NC 60-136 (PC); Bourail, same host, 13 VII 1960, leg. & det. Marty NC 60-111, 60-113 (PC); Ouaco, same host, 10 IX 1960, leg. Huguenin NC 60-135; Canala, same host, 11 VIII 1960, leg. & det. Marty NC 60-119 (PC).

LI: Lifou, same host, 5 XII 1958, leg. & det. Bugnicourt NC 58-080 (PC); same locality and host, 9 VII 1960, leg. & det. Marty NC 60-110 (PC). - PS: Fiji, Koronivia, same host, 1 VI 1963, leg. & det. Huguenin PS 63-071(PC).

⇒***Puccinia posadenis*** Sacc. & Trott. 1912 in Sacc. - Syll. Fung. XXI: 691; Cummins 1953 - Uredineana IV: 21-23.

= *Puccinia kaernbachii* Arthur 1919. Bull. Torrey Bot. Club 46: 110.

Lit.: Not cited by Reed & Farr (1993).

NC: Nouméa, Vallon Dore, on *Capillipedium spicigerum*, 18 V 1964, leg. & det. Huguenin, NC 64-258 (PC: formerly identified as *Puccinia kaernbachii*).

The presence of *Puccinia posadenis* on this host requires confirmation.

⇒***Puccinia purpurea*** Cooke 1876. Grevillea 5: 15.

Lit.: VII: 657; Huguenin 1966: 263.

NC:Nouméa, Centre Agronomique, Port-Laguerre, on *Sorghum vulgare* (Poaceae), 28 XI 1958, leg. & det. Bugnicourt NC 58-070 (PC); same locality and host, 1 V 1966, leg. & det. Huguenin NC 66-016 (PC); same locality and host, 30 XI 1965, leg. & det. Huguenin NC 66-039 (PC); same locality and host, 1 I 1968, leg. & det. Huguenin NC 68-000 (PC); Ouaco, same host, 5 VIII 1959, leg. & det. Bugnicourt NC 59-041 (PC).

⇒***Puccinia pusilla*** Sydow ap. Sydow & Butler 1906. Ann. Mycol. 4: 435.

Lit.: XXI: 693; Huguenin 1966: 263.

NC: Nouméa, Vallon Dore, on *Capillipedium spicigerum* (Poaceae), 18 V 1964, leg. & det. Huguenin NC 64-258 (PC).

⇒***Puccinia rufipes*** Dietel 1902. Engler's bot Jahrb. 32: 48.

Lit.: XVII: 377; Huguenin 1966: 263.

NC: Gwereu, Houaïlou, on *Imperata cylindrica* (Poaceae), 27 VII 1964, leg. & det. Huguenin NC 64-346 (PC); Dumbéa, same host, 14 VII 1966, leg. & det. Huguenin NC 66-026 (PC); Mont Mou, same host, 20 XI 1966, leg. & det. Huguenin NC 66-069 (PC).

⇒***Puccinia sorghi*** Schwein. 1831. North Amer. Fungi: 295, No. 2910; Trans. Amer. Phil. Soc., ser. 2, 4: 295. 1832.

Lit.: VII: 659; Huguenin 1966: 263; 1967: 948.

NC: Ouaco, on *Zea mays* (Poaceae), 10 IX 1960, leg. & det. Bugnicourt NC 60-135 (lost); Pouembout, same host, 10 IX 1960, leg. Marty, det. Huguenin NC 60-136 (lost); La Foa, same host, 27 VIII 1966, leg. & det. Huguenin NC 66-050 (PC); same locality, on *Oxalis corniculata* (Oxalidaceae), 27 VIII 1966, leg. & det. Huguenin NC 66-067 (PC).

⇒***Puccinia thiensis**** B. Huguenin (1967) 1968. Bull. Soc. Mycol. Fr. 83: 950.

NC: Nouméa, Forêt de Thi, on living leaves of *Paspalum orbiculare* (Poaceae), 1 IX 1966, leg. Huguenin 66-046 (holotype, PC).

⇒***Puccinia triticina*** Erikss. 1899. Ann. Sci. Nat., sér. VIII, 9: 270.

Lit.: XVII: 376, 469; Huguenin 1966: 263.

NC: Ouaco, on *Triticum vulgare* (Poaceae), 22 X 1964, leg. & det. Huguenin NC 64-492 (PC); Pouembout, 23 X 1964, leg. & det. Huguenin NC 64-496 (PC); Nouméa, Centre Agronomique, Port-Laguerre, same host, 16 XI 1964, leg. & det. Huguenin NC 64-531 (PC).

Cummins (1971) regards this rust fungus as a synonym of *Puccinia recondita* Roberge ex Desm. *sensu lato* but such disposition has apparently not received general agreement.

⇒***Pucciniastrum boehmeriae*** Sydow 1903. Ann. Mycol. 1: 19.

Uredinial state : *Uredo boehmeriae* Dietel 1900. Engler's Bot. Jahrb. 28: 290.

Lit.: XVII: 401; Huguenin (1967) 1968: 950.
NC: Col d'Amieu, on *Boehmeria platyphylla* (Urticaceae), 4 V 1966, leg. & det. Huguenin NC 66-024 (PC); same locality and host, 20 VI 1967, leg. & det. Huguenin NC 67-069 (PC).

⇒***Ravenelia neocaledoniensis**** B. Huguenin 1966. Bull. Soc. Mycol. Fr. 82: 266.
NC: Nouméa, IFO, on twigs, petioles and leaves of *Acacia farnesiana* (Mimosaceae), 23 IX 1964, leg. Huguenin 64-462 (holotype, PC). Isotypes: Route Territoriale No. 1, Km 79 N Nouméa, same host, 9 V 1963, leg. Huguenin NC 63-060 (PC); same locality and host, 23 VII 1963, leg. Huguenin NC 63-112 (PC).

As stated by Mordue (1988), autoecious species of *Ravenelia* Berk. are generally considered to be highly host-specific. A global revision of the described taxa is urgently needed.

⇒***Sphaerophragmium acaciae*** (Cooke) Magnus 1891. Ber. Deutsch. Bot. Ges. 9: 121.
Bas.: *Triphragmium acaciae* Cooke 1880. Grevillea 8: 94.
Lit.: XI: 209; Huguenin 1966: 266.
NC: Voh, on *Albizzia lebbeck* (Caesalpiniaceae), 6 VIII 1959, leg. & det. Bugnicourt NC 59-046 (PC); Bourail, same host, 8 V 1963, leg. & det. Huguenin NC 63-057 (PC); Pouembout, same host, 22 X 1964, leg. & det. Huguenin NC 64-498 (PC). - PF: Iles Gambier, Taravari, same host, 21 VI 1966, leg. & det. Huguenin PS 66-075 (PC).

⇒***Sphacelotheca schoenanthii*** (H. & P. Sydow & Butler) Zundel 1930. Mycologia 22: 136.
Bas.: *Uromyces schoenanthii* H. & P. Sydow & Butler 1906. Ann. mycol. 4: 425.
Lit.: XXI: 588; XXVI: 525 (as *Sphacelotheca*).
NC : Col d'Amieu, on *Themeda gigantea*, 20 IV 1967, leg. & det. Huguenin, NC 67-109 (PC).

⇒***Sphacelotheca tonglinensis*** (Tracy & Earle) Zundel 1944. Mycologia 36: 406.
Bas.: *Ustilago tonglinensis* Tracy & Earle 1895. Bull. Torr. bot. Club 22: 175.
Lit.: XIV: 420.
NC : Col de la Pirogue, on *Ischaemum muticum* (Poaceae), 5 I 1966, leg. & det. Huguenin, NC 66-031 (PC); specimen erroneously labelled *Sphaerophragmium tonglinensis* (Tracy & Earle) Zundel.

⇒***Sporisorium caledonicum**** (Pat.) Vanky 1991. Mycotaxon 40: 165. 1991.
Bas.: *Sorosporium caledonicum** Pat. 1887c. Bull. Soc. Mycol. Fr. 3: 173.
Lit.: VII: 514, IX: 289, XII: 709, XX: 809.
NC: Locality and collector unknown, on *Heteropogon contortus* (Poaceae), 141 (holotype, PC; isotype, FH; Pfister, 1977.

Reported to destroy completely the flowers of its host-plant. *Sorosporium* is clearly a spelling mistake of the validly published *Sporisorium* Ehrenberg in Link (Langdon & Fullerton, 1978; Vanky, 1991). No recent collection of this smut has been made.

⇒***Sporisorium sorghi*** Ehrenberg ex Link 1825. In Linné's Species plantarum ed. 4, 6(2): 86.
= *Sphacelotheca sorghi* (Ehrenberg ex Link) Clinton 1902. J. Mycol. 8: 140.
Lit.: XVII: 487. [as *S. sorghi* (Link) Clinton].
PS : Fiji, *Sorghum* sp., 7 XII 1960, leg. & det. Marty, PS 60-149 (PC).

⇒***Tranzschelia pruni-spinosae*** (Pers.: Pers.) Dietel 1922. Ann. Mycol. Berl. 20: 31.
Bas.: *Puccinia pruni-spinosae* Pers.: Pers. 1801. Syn. Meth. Fung.: 226.
Lit.: VII: 648 (as *P. pruni-spinosae*); Huguenin 1966: 266.

NC: Mont Dore, on *Armeniaca vulgaris* (Rosaceae), 19 VIII 1960, leg. Marty, det. Huguenin, NC 60-125 (PC); same locality, on *Prunus domestica* (Rosaceae), 19 VIII 1960, leg. Marty, det. Huguenin NC 60-126 (PC); Nouméa, Centre Agronomique, Port-Laguerre, same host, 23 IX 1964, leg. & det. Huguenin NC 64-463 (PC).
PF: Iles Gambier, Rikitea, Mangareva, same host, 2 IV 1966, leg. & det. Huguenin PS 66-083 (PC).

⇒***Uredo*** sp.
NC : Doneva, *Tiliaceae* (?), 15 VI 1965, leg. & det. Huguenin, NC 65-075 (PC).

⇒***Uredo cassiae-glaucae*** Sydow 1903. Ann. Mycol. 1: 331.
Lit.: XVII: 448; Huguenin 1966: 267.
NC: Nouméa, IFO, on *Cassia* sp. (Caesalpiniaceae), 10 VIII 1963, leg. & det. Huguenin NC 63-063 (PC).

⇒***Uredo*** cf. ***erythrinae*** P. Henn. 1908. Ann. Mus. du Congo Vol. II, fasc. III: 224.
Lit.: XXI: 790.
NC : Tü, Houaïlou, on *Erythrina* sp., 22 VII 1964, leg. & det. Huguenin, NC 64-321 (PC).

⇒***Uredo musae*** Cummins 1941. Mycologia 33: 151.
PS : Fiji, on *Musa sapientum*, 27 VII 1960, leg. & det. Marty, PS 60-115 (PC); Koronivia, Fiji, 1 VI 1963, leg. & det. Marty, PS 63-076 (PC).

⇒***Uredo pseudocannae*** Cumm. 1941. Mycologia 33: 386.
Lit.: Huguenin 1966: 267.
NC: Vallée de la Tiwaka, on *Canna indica* (Cannaceae), 19 VII 1961, leg. Marty, det. G. F. Laundon, NC 61-165 (PC).

⇒***Uromyces appendiculatus*** (Pers.: Pers.) Unger 1836. Einfl. Bodens, 216.
Bas.: *Uredo appendiculata* Pers. 1796. Obs. myc. I: 17.
Syn.: *Uromyces phaseoli* (Pers.) G. Winter 1880. Hedwigia 19: 37.
Lit.: VII: 535; XV: 441 (= *U. appendiculatus*); Huguenin 1966: 268.
NC: Nouméa, Centre Agronomique, Port-Laguerre, on *Phaseolus vulgaris* (Papilionaceae), 28 XII 1958, leg. & det. Bugnicourt NC 58-072 (PC); same locality and host, 16 VI 1966, leg. & det. Huguenin NC 66-020 (PC); Ponerihouen, 1 IX 1959, leg. & det. Bugnicourt NC 59-050 (PC); Poindimié, same host, 3 X 1963, leg. Marty, det. Huguenin NC 63-113 (PC); Nouméa, same host, 1 VII 1963, leg. & det. Huguenin NC 63-128 (PC); Pouembout, same host, 21 X 1964, leg. & det. Huguenin NC 64-502 (PC); Dumbéa, same host, 20 V 1965, leg. Huguenin NC 65-054 (PC).

⇒***Uromyces bidenticola*** Arthur 1917. Mycologia 9: 71.
Uredinial state: *Uredo bidenticola* P. Henn. 1898. Hedwigia 37: 279.
Lit.: XVI: 356 (as *Uredo bidenticola*); Huguenin 1966: 268.
NC: Monts Koghis, on *Bidens pilosa* (Asteraceae), 26 VII 1964, leg. & det. Huguenin NC 64-394 (PC).

⇒***Uromyces clignyi*** Pat. & Har. 1900. J. Bot. (Morot) 14: 237.
Lit.: XVI: 268; Huguenin 1966: 268.
NC: Tontouta (Route Territoriale, No. 1), on *Heteropogon contortus* (Poaceae), 20 VII 1964, leg. & det. Huguenin NC 64-342 (PC); Nouméa, IFO, same host, 21 IX 1964, leg. & det. Huguenin NC 64-488 (PC); same locality and host, 3 X 1964, leg. & det. Huguenin NC 64-513 (PC); La Crouen, same host, 8 VI 1967, leg. & det. Huguenin NC 67-112 (PC).

⇒***Uromyces commelinae*** Cooke 1887. Trans. Roy. Soc. Edin. 31: 342, fig. 104.
Lit.: VII: 573.

NC : Col de la Pirogue, on *Commelina nudiflora*, 8 VII 1967, leg. & det. Huguenin, NC 67-089 (PC).

⇒***Uromyces euphorbiae*** Cooke & Peck in Peck 1873. Ann. Rep. N.Y. State Mus. 25: 90.

Lit.: VII: 572; Huguenin 1966: 268.

NC: Nouméa, IFO, on *Euphorbia tannensis* (Euphorbiaceae), 7 XII 1962, leg. Huguenin, det. Viennot-Bourgin NC 63-011 (PC). - PF: Iles Gambier, Rikitea, Mangareva, same host, 1 IV 1966, leg. & det. Huguenin PS 66-073 (PC). - PS: Vanuatu, same host, 12 II 1964, leg. & det. Huguenin PS 64-010 (PC).

⇒***Uromyces inocarpi*** Rac. 1900. Parasit. Algen und Pilze Javas III: 9.

Lit.: XVI: 264.

PF: Tahiti, Papeari, on *Inocarpus fagiterus* (Papilionaceae), 28 VIII 1964, leg. Millaud, det. Huguenin, PS 64-378 (PC).

⇒***Uromyces phyllodiorum*** (Berk. & Broome) McAlpine 1906. Rusts Australia: 95.

Bas.: *Melampsora phyllodiorum* Berk. & Broome 1883. Fungi from Brisbane: 67, No. 258, t. XV, f. 6-8.

Lit.: VII: 594 (as *M. phyllodiorum*); XX: 1087 (as *U. phyllodiorum*); Huguenin 1966: 268.

NC: Canala, Nakety, on *Acacia spirorbis* (Mimosaceae), 2 VI 1963, leg. Marty, det. Huguenin NC 63-067 (PC); Houaïlou, same host, 30 IX 1963, leg. & det. Huguenin NC 63-118 (PC). - LI: Lifou, on *Acacia spirorbis* (Mimosaceae), 4 XII 1958, leg. Marty, det. Huguenin NC 58-071 (PC); same locality and host, 3 XI 1964, leg. & det. Huguenin NC 64-516 (PC) and 5 XI 1964, leg. & det. Huguenin NC 64-522 (PC).

⇒***Uromyces setariae-italicae*** Yoshino 1906. Bot. Mag. Tokyo 20: 247.

= *Uromyces leptodermus* H. & P. Sydow in H. & P. Sydow & Butler 1906. Ann. Mycol. 4: 430; Ann. Mycol. V: 493. 1907.

Lit.: XX:1091;XXI: 593 (as *U. leptodermus*); Huguenin 1966: 270.

NC: Col d'Amieu, on *Paspalum scrobiculatum* (Poaceae), 20 IV 1967, leg. & det. Huguenin, NC 67-067 (PC); Nouméa, Anse Vata, on *Brachiaria reptans*, 22 III 1967, leg. & det. Huguenin, NC 67-078 (PC); Vallée de la Tiwaka, on *Brachiaria mutica,* 3 X 1963, leg. & det. Huguenin, NC 63-173 (PC: formerly identified as *U. leptodermus);* Pidgen, same host, 22 X 1964, leg. & det. Huguenin NC 64-499 (PC: formerly identified as *U. leptodermus*); Bacco-Kouné, same host, 22 X 1964, leg. & det. Huguenin NC 64-500 (PC: formerly identified as *U. leptodermus*). - LI: Lifou, Wu, on *Stenotaphrum subulatum* (Poaceae), 3 XI 1964, leg. & det. Huguenin NC 64-512 (PC).

⇒***Uromyces striatus*** Schröt. 1870. Abhandl. Schles. Ges. Vatrerl. Cult. Nat. Abh. 1868-72: 11.

Lit.: VII: 542; Huguenin 1966: 271.

NC: Ouaco, on *Medicago lupulina* (Papilionaceae), 13 IX 1965, leg. & det. Huguenin NC 65-072 (PC); same locality and host, 2 VI 1966, leg. & det. Kohler NC 66-019; Dumbéa, same host, 9 XII 1965, leg. & det. Huguenin NC 66-099. - LI: Lifou, on *Medicago sativa* (Papilionaceae), 12 V 1958, leg. & det. Bugnicourt NC 58-083 (PC). - PS : Tagabe, Vanuatu, same host, 13 XI 1963, leg. & det. Huguenin PS 63-194 (PC).

⇒***Uromyces vignae*** Barclay 1891. Journ. Asiat. Soc. of Bengal 60(2): 211.

= *Uromyces phaseoli* (Pers.) G. Winter var. *vignae* (Barclay) Arthur 1934. Manual Rusts U.S. Canada, 297.

Lit.: Huguenin (1967) 1968: 951.

NC: Nouméa, Mont Dore, on *Vigna lutea* (Papilionaceae), 1 VII 1966, leg. & det. Huguenin NC 66-036 (PC). - LI: Lifou, Mou, on *Vigna lutea* (Papilionaceae), 14 IV

1967, leg. & det. Huguenin NC 67-053 (PC). - PF: Iles Gambier, Akamaru, 7 IV 1966, leg. & det. Huguenin, PS 66-079 (PC).

⇒***Uromyces wedeliae*** P. Henn. 1904. Hedwigia 43: 150.
Lit.: XVII: 245; Huguenin 1966: 271.
NC: Mont Dore, on *Wedelia biflora* (Asteraceae), 21 IX 1965, leg. & det. Huguenin NC 65-073 (PC); Ponérihouen, same host, 1 V 1966, leg. & det. Huguenin NC 66-035 (PC).

⇒***Uromycladium tepperianum*** (Sacc.) Mc Alpine 1905. Ann. Mycol. 3: 310.
Bas.: *Uromyces tepperianum* Sacc. 1889. Hedwigia 28: 126.
Lit.: IX: 291 (as *Uromyces tepperianum*); XXI: 596 (as *Uromycladium tepperianum*); Huguenin 1966: 271.
NC: Nouméa, Ouen-Toro, on *Acacia spirorbis* (Mimosaceae), 25 IX 1963, leg. & det. Huguenin NC 63-106 (PC). - PS: Vanuatu, Port Havannah, same host, 25 I 1964, leg. & det. Huguenin PS 64-041 (PC).

⇒***Ustilaginoidea virens*** (Cooke) Takahashi 1896. Bot. Mag., Tokyo 10: 16-20.
Bas.: *Ustilago virens* Cooke 1878. Grevillea 7: 13-15.
Lit.: VII: 467a (as *Ustilago virens*).
PS: Fiji, Koronivia, on *Oryza sativa* (Poaceae),1 VI 1963, leg. & det. Huguenin, PS 63-075 (PC).

⇒***Ustilago cynodontis*** (P. Henn.) P. Henn. 1893. Bull. Herb. Boissier 1: 114.
Lit.: XI: xxi [as *U. cynodontis* (P. Henn.) Bref.].
NC: IFO, Nouméa, on *Cynodon dactylon* (Poaceae), 19 III 1963, leg. & det. Huguenin, NC 63-153 (PC).

⇒***Ustilago nuda*** (Jensen) Kellerman & Swingle 1890. Kansas Agric. Exp. sta. Annual Rep. 2: 227.
Lit.: IX: 283 (as *U. nuda* var. *hordei* Jensen).
NC : Nouméa, Centre Agronomique, Port Laguerre, on *Hordeum vulgare* (Poaceae), 23 X 1964, leg. & det. Huguenin, NC 64-495 (PC).
Current name: *Ustilago nuda* (Jens.) Rostrup 1889. Tidskr. Landoekon. Ser. 5, 8: 745 (*nomen nudum*).

⇒***Ustilago tritici*** (Pers.) Rostrup 1890 (March). Overs. Kongel. Danske Vidensk. Selsk. Forh. Medlemmers Arbeider: 15.
Bas.: *Uredo segetum* Pers. β *Uredo tritici* Pers 1801. Syn. meth. Fung. : 224.
NC: Pouembout, on *Triticum sativum*, 22 X 1964, leg. & det. Huguenin, NC 64-508 (PC).

The identitiy of this smut fungus with *Ustilago nuda* (Jensen) Kellerman & Swingle as proposed by Punithalingam & Waterston (1970) was refuted by Vánky (1994).

AKNOWLEDGEMENTS

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HOST-FUNGUS INDEX

Acacia farnesiana	Ravenelia neocaledoniensis
Acacia spirorbis	Uromyces phyllodiorum, Uromycladium epperianum
Agathis moorei	Aecidium balansae
Agathis ovata	Aecidium balansae
Albizzia granulosa	Dicheirinia vienottii
Albizzia lebbeck	Sphaerophragmium acaciae
Antirrhinum majus	Puccinia antirrhini
Armeniaca vulgaris	Tranzschelia pruni-spinosae
Avena sativa	Puccinia coronata, Puccinia graminis
Bambusa sp.	Dasturella divina
Bambusa vulgaris	Dasturella divina
Bidens pilosa	Uromyces bidenticola
Boehmeria platyphylla	Pucciniastrum boehmeriae
Bothriochloa pertusa	Puccinia duthiae
Brachiaria mutica	Uromyces setariae-italicae
Brachiaria reptans	Uromyces setariae-italicae
Breynia disticha var. disticha f. nivosa	Masseeella breyniae
Canna indica	Puccinia cannae, Uredo pseudocannae
Capillipedium spicigerum	Puccinia kaernbachii, Puccinia pusilla
Cassia sp.	Uredo cassiae-glaucae
Cenchrus echinatus	Puccinia cenchri
Cocos nucifera	Graphiola cocoina
Coffea arabica	Hemileia vastatrix
Commelina nudiflora	Uromyces commelinae
Crepis japonica	Puccinia crepidis-japonicae
Cymbopogon nardus	Puccinia nakanishikii
Cynodon dactylon	Puccinia cynodontis, Ustilago cynodontis
Cyperus odoratus	Cintractia peribebuyensis, Puccinia sp. 2
Dammara ovata	Aecidium balansae
Digitaria adscendens	Puccinia levis var. panici-sanguinalis
D. sanguinalis	Puccinia levis var. panici-sanguinalis
Dioscorea bulbifera	Goplana dioscoreae
Elephantopus mollis	Coleosporium elephantopodis
Erythrina spp.	Phakopsora pachyrhizi, Uredo cf. erythrinae
Euphorbia tannensis	Uromyces euphorbiae
Ficus sp.	Cerotelium fici
Ficus carica	Cerotelium fici
Fimbristylis ferruginea	Puccinia sp. 1
Gossypium sp.	Phakopsora gossypii
Heteropogon contortus	Sporisorium caledonicum, Uromyces clignyi
Hordeum vulgare	Ustilago nuda
Imperata cylindrica	Puccinia rufipes
Inocarpus fagilerus	Uromyces inocarpi
Inocarpus edulis	Mapea radiata
Ipomoea pes-caprae	Aecidium kaernbachii
Ischaemum muticum	Sphacelotheca tonglinensis
Medicago lupulina	Uromyces striatus

Medicago sativa	Uromyces striatus
Miscanthus japonicus	Puccinia erythropus
Monstera deliciosa	Puccinia paullula
Mucuna urens	Phakopsora pachyrhizi
Musa sapientum	Uredo musae
Oryza sativa	Ustilaginoidea virens
Oxalis corniculata	Puccinia sorghi
Palms	Graphiola phoenicis
Paspalum orbiculare	Puccinia paspalina, Puccinia thiensis
Paspalum paniculatum	Puccinia paspalina
Paspalum scrobiculatum	Uromyces setariae-italicae
Pelargonium zonale	Puccinia pelargonii-zonalis
Phaseolus vulgaris	Uromyces appendiculatus
Phoenix sp.	Graphiola phoenicis
Prunus domestica	Tranzschelia pruni-spinosae
Rhynchelytrum repens	Puccinia levis var. tricholaenae
Rubus roseafolius	Hamaspora acutissima
Saccharum officinarum	Puccinia kuehnii
Smilax ligustrifolia	Puccinia kraussiana
Smilax neocaledonica	Puccinia kraussiana
Smilax orbiculata	Puccinia kraussiana
Smilax plurifurcata	Puccinia kraussiana, Puccina henryana
Smilax purpurata	Puccinia lifuensis, Puccina montisfontium
Sorghum sp.	Sporisorium sorghi
Sorghum vulgare	Puccinia purpurea
Stenotaphrum subulatum	Uromyces setariae-italicae
Tabernaemontana orientalis	Puccinia engleriana
Themeda gigantea	Sphacelotheca schoenanthii
Tiliaceae (?)	Uredo sp.
Torulinium ferax	Puccinia sp. 2, Ustilago sp.
Triticum sativum	Ustilago tritici
Triticum vulgare	Puccinia triticina, Puccina graminis
Vigna lutea	Uromyces vignae
Wedelia biflora	Uromyces wedeliae
Zea mays	Puccinia polysora, Puccina sorghi

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REAPPRAISAL OF SPHAERIA ORDINATA SENSU BROOME

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SUMMARY

The fungus determined as *Sphaeria ordinata* by Broome is reappraised in light of modern collections. This taxon belongs in *Saccardoella* and the earliest name for it is presented in new combination as *Saccardoella graeweana*.

An interesting collection from Sweden matches in all respects one from Massachusetts, USA. Our search for a name to designate this fungus led us on a trail of misconceptions in the literature that we will attempt to clarify. Several names have been applied to the taxon. Riedl (1970) described as *Zignoëlla dolichospora* Sacc. 1878 a fungus that is identical to the one under consideration. Höhnel (1909a) had described it from a collection bearing the herbarium name of *Ceratosphaeria quercina* Henn. that he identified as *Zignoëlla dolichospora*. Höhnel (1909b) synonymized this name under *Z. ordinata* (Fr.) Sacc. 1878. *Sphaeria ordinata* Fr. 1823 was assigned as a variety of *Hypoxylon udum* Pers.: Fr. by Fries in 1832, and has since been synonymized under *H. udum* (Nitschke 1867, Miller 1961, Ju and Rogers 1996), i.e., *Euepixylon udum* (Pers.: Fr.) Laessøe & Spooner 1995. *Sphaeria ordinata* has also been designated as *Hypospila ordinata* (Fr.) Bonord. 1864, *Winteria ordinata* (Fr.) Sacc. 1882, and *Melanomma ordinatum* (Fr.) G. Wint. 1886.

Höhnel's (1909b) understanding of '*Sphaeria ordinata*' was derived from a collection made by Broome, described and illustrated under this name by Berkeley & Broome (1861). These authors wrote that "This appears to be the plant of Fries." Their description and illustration (Pl. XVII, fig. 26) make it obvious that Broome's specimen,

distributed as Rabenhorst, Fungi europaei no. 329, 1861, and our collections are the same, although they differ from *Sphaeria ordinata*. The copy in UPS confirms their identity. These collections also differ from *Zignoëlla dolichospora*; type material of this fungus in Saccardo, Mycotheca veneta no. 1359, 1879, studied by Höhnel was old and useless. The isotype copy in UPS does contain a fungus that differs from ours, particularly in ascospore shape and septation, but is a good match of Saccardo, Fungi Italici p. 342, and Berlese's (1892) illustration (Icones Fungorum I, tab. 93, fig. 3).

Fortunately, another epithet is available. In 1867 O.S. Blomberg, a Swedish clergyman and ardent lichenologist, published a small paper on the lichens of Kinnekulle, a mountain in Västergötland, south Sweden. Among the taxa he included a new species *Sagedia graeweana* Blomb., said to be a lichen on *Fraxinus*. Type material in UPS was studied by Keissler who annotated the specimen and noted its disposition as *Zignoëlla ordinata* (Keissler (1937-38), citing Höhnel's (1909b) article. Eriksson (1992) included *Z. ordinata* with synonym *Segestria graeweana* in his checklist of Swedish pyrenomycetes. Holm and Holm have compared and recognize the identity of this and their recent collection. This rarely collected species has the attributes of a species of *Saccardoella*: firm, dark peridium, narrow asci in paraphyses, and hyaline, distoseptate ascospores. Its transfer to that genus is proposed.

Saccardoella graeweana (Blomb.) M.E. Barr, L. Holm & K. Holm, comb. nov. Fig. 1a-c

Sagedia graeweana Blomb., Öfvers. K. Vetensk.-Akad. Förh. 24: 123. 1867.

Segestria graeweana (Blomb.) Blomb. & Forssell, Enum. Pl. Scand. 4: 105. 1880.

Porina graeweana (Blomb.) Zahlbr., Catal. Lich. Univ. 1: 383. 1922.

Ascomata superficial, scattered or often gregarious and seated on wood, upright or tilted, obpyriform to conoid, 200-250 µm wide, 280-350 µm high; ostiole periphysate; peridium firm, carbonaceous, dark reddish brown, ca. 15-17 µm wide, composed of compressed rows of small, thick-walled cells. Asci unitunicate, 75-120 x 8-10 µm, cylindric, stipitate; apical ring narrow, refractive, nonamyloid. Paraphyses narrow, 1-2 µm wide, septate, in gel matrix above asci. Ascospores 30-40 x 3-5.5 µm, hyaline, elongate fusoid, usually widest above, tapering to pointed base, less tapered to apex, up to 10-14-distoseptate, first-formed septum median, later-formed septa developing progressively toward ends, cells rectangular; wall smooth; overlapping biseriate in the ascus.

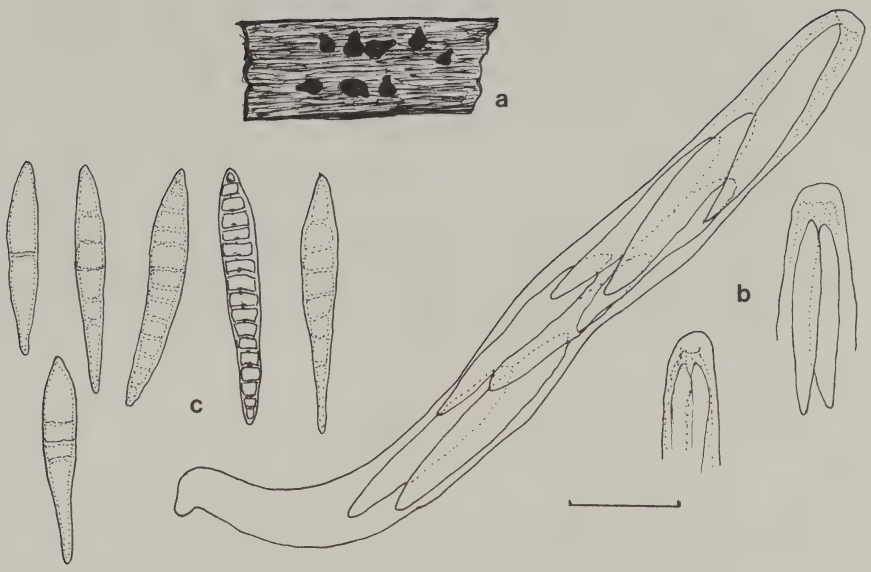


Fig. 1. *Saccardoella graeweana*. a. Habit sketch of ascomata. b. Ascus and two ascus apices. c. Ascospores, young and mature. Scale line = 15 µm for b and c; habit not to scale.

Recent collections examined: SWEDEN: Skäne: Vitaby parish, Stenshuvud, pasture SE of the parking, on canes of *Rubus fruticosus* coll., 5 May 1985, K. & L. Holm 3802e (DAOM, UPS). USA: Massachusetts, Franklin Co., Conway State Forest, on dead wood of *Castanea dentata* (Marsh.) Borkh., 21 Jul 1960, M.E. Barr 2724c (NY, UPS).

We are greatly indebted to Dr. R. Santesson for providing detailed information on the synonymy of the presumed lichen. We thank Dr. S. Huhndorf for reviewing the manuscript.

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SYNONYMY OF TOFISPORA & THANATEPHORUS, WITH NOTES ON A NEW COLLECTION FROM PUERTO RICO

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The new combinations *Thanatephorus biapiculatus*, *T. hebelomatosporus*, and *T. repetospora* are proposed. *Thanatephorus hebelomatosporus* is redescribed and illustrated from a Puerto Rican collection.

The genus *Tofispora* G. Langer was proposed by Langer (1994) to accommodate three tropical species differing from *Thanatephorus* Donk only by having warted rather than smooth basidiospores. In the same monograph, smooth, warted, and spiny-spored species were accepted in the genus *Botryobasidium* Donk (inclusive of *Botryohypochnus* Donk), so that the criterion of 'wartiness' was not consistently applied. Since *Tofispora* is not otherwise distinct from *Thanatephorus*, it is here considered a synonym.

Tofispora species are infrequently collected and the whole genus is only known from a dozen or so specimens. The present paper redescribes one of these species, *Tofispora hebelomatospora*, based on the holotype from Africa (Gabon) plus a new collection from the Caribbean (Puerto Rico).

Thanatephorus hebelomatosporus (Boidin & Gilles) P. Roberts **comb. nov. FIGS. 1 & 2**

Botryohypochnus hebelomatosporus Boidin & Gilles, *Mycotaxon* 14: 287 (1982)
Tofispora hebelomatospora (Boidin & Gilles) G. Langer, *Bibl. Myc.* 158: 334 (1994)

Basidiomes: effused, thin, hypochnoid, greyish to beige, ochraceous to brown when dried. *Hymenium:* comprising one or more layers of basidia on vertically branching, cymose, thin-walled hyphae arising from a subicular layer of wider, thick-walled, basal hyphae. *Hyphae:* in the subhymenium 7 - 10 µm wide, hyaline, thin-walled, composed of short, somewhat swollen hyphal compartments; in the subiculum 12 - 16 µm wide, ochraceous to pale brown, with walls up to 2.5 µm thick, sometimes double-laminate, composed of long, straight hyphal compartments; clamp-connexions absent. *Basidia:* ellipsoid to broadly clavate (Q = 1.4 - 1.6), 16 - 21 x 11 - 13 µm. *Sterigmata:* (1 -) 4 - 5 (-6), 5 - 10 x 2 - 2.5 µm. *Basidiospores:* amygdaliform (Q = 1.7 - 2.1), 10.5 - 13.5 x 5 - 7 µm, pale brown, somewhat thick-walled, densely covered with fine but distinct warts, not seen to produce secondary spores.

Specimens examined: GABON: 14km N. of Libreville, on fallen trunk, 7 Dec. 1978, G. Gilles, holotype, **LY 9022**; PUERTO RICO: Bosque Nacional del Caribe, Bisley, on bamboo stem, 6 Jun. 1997, P. Roberts 909, **K(M) 54736**.

Thanatephorus hebelomatosporus is distinguished by its large, brownish, amygdaliform basidiospores which are clearly warted and have not been seen to produce secondary spores. The lack of basidiospore replication led to the species originally being referred to *Botryohypochnus* Donk, a genus synonymized with *Botryobasidium* by Langer (1994). However, Langer (1994) considered the general morphology of *T. hebelomatosporus* to be typical of *Thanatephorus*-like taxa with warted spores, for which she created the genus *Tofispora*. In particular, she considered the ultrastructure of the spore decoration to be homologous with that in the type species of *Tofispora* and distinct from that found in warted-spored species of *Botryobasidium*. Since *Tofispora* is not recognized here as a genus distinct from *Thanatephorus*, a new combination is proposed.

Thanatephorus hebelomatosporus is infrequently collected and was only previously known from the type locality (Gabon) and from Argentina (Hjortstam & Ryvarden, 1986). The collection from Puerto Rico (Fig. 2) differs from the type (Fig. 1) only in being consistently 4-sterigmate (most basidia in the type collection are 5-sterigmate) and in having slightly smaller basidiospores (10.5 - 11.5 x 5 - 6 µm compared to 10.5 - 13.5 x 5 - 7 µm in the type). These distinctions are considered to fall within the normal variation of a single, pantropical species.

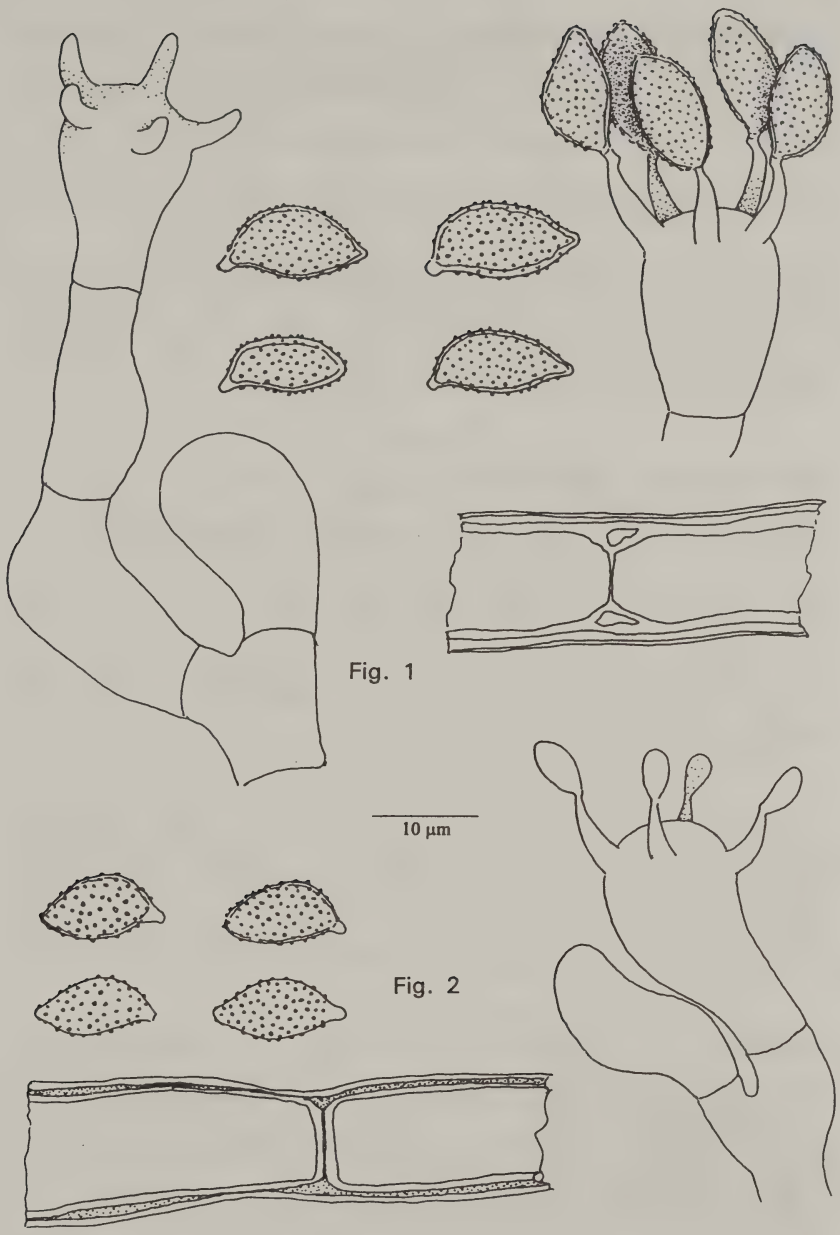


Fig. 1

Fig. 2

Thanatephorus hebelomatosporus: **Fig. 1.** (Gabon, type). Basidia (5-spored); warted basidiospores; double-laminate, basal hypha. **Fig. 2.** (Puerto Rico, P. Roberts 909). Warted basidiospores; basidium; double-laminate, basal hypha.

Thanatephorus biapiculatus (D.P. Rogers) P. Roberts **comb. nov.**
Pellicularia biapiculata D.P. Rogers, in Martin, *Lloydia* 7: 71 (1944)
Botryohypochnus biapiculatus (D.P. Rogers) Parmasto, *Eesti NSV Tead. Akad. Toim Biol.* 14: 221 (1965)
Tofispora biapiculata (D.P. Rogers) G. Langer, *Bibl. Myc.* 158: 328 (1994)

Specimens examined: BRAZIL: São Leopoldo, Dec. 1939, J. Rick, holotype, **IA 371814**; MALAWI: Thyolo Mt., on wood, 13 Mar. 1973, L. Ryvarden 11530, **K(M) 30003**.

Thanatephorus biapiculatus has basidiospores which are citriform and smaller than those of *T. hebelomatosporus.* In the type collection from Brazil (cited above) and in specimens from Ethiopia (Langer, 1994), no secondary spores can be found, but material from Tanzania (Hjortstam, 1983) and Malawi (cited above) shows spore replication.

Thanatephorus repetospora (G. Langer & Ryvarden) P. Roberts **comb. nov.**
Tofispora repetospora G. Langer & Ryvarden, *Bibl. Myc.* 158: 338 (1994)

Specimen examined: ETHIOPIA: Shoa Province, Ginchu, Chilomo Forest, on wood, 10 Jul. 1990, L. Ryvarden 28060, isotype, **K(M) 52685**.

Thanatephorus repetospora is only known from the type specimen (cited above), but is distinct in having subglobose, warted basidiospores which produce secondary spores.

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ECTOMYCORRHIZAL FUNGI AT TREE LINE IN THE CANADIAN ROCKIES

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Abstract

Sporocarps of fungi belonging to ectomycorrhizal genera were collected between 1993 and 1997 at two sites at the upper elevational limit of the subalpine forest in montane Alberta. Host plants include *Abies lasiocarpa, Picea engelmannii, Larix lyallii, Betula glandulosum,* and *Dryas* and *Salix* spp. Eighty one species in 29 genera and 13 families were collected, 22 of which are new records for Canada, 35 for western Canada and 40 for Alberta. The community of ectomycorrhizal fungi in the transition zone between the subalpine forest and the alpine zone was composed mainly of conifer associates. Arcto-alpine angiosperm associates and generalists were also present. Although the subalpine/alpine ecotone was richest in terms of ectotrophic plant genera, mycorrhizal fungi were richest in the subalpine forest. Taxa collected are annotated with information on host association and distribution, and are described where appropriate.

Key words: alpine, subalpine, montane, ecotone, *Abies, Picea, Salix, Dryas*

Introduction

Montane ecosystems are often rich in ectomycorrhizal fungi which may fruit abundantly and include species endemic to high elevation environments. European records of montane ectomycorrhizal fungi include those from *Picea*-dominated subalpine forests (Favre 1960, Treu 1990, Rücker *et al.* 1990, Bieri *et al.* 1992) and the well documented *Salix*-dominated alpine habitats (Favre 1955, Lamoure 1977, 1978, 1987, Horak 1960, 1987, Kühner and Lamoure 1986, Senn-Irlet 1988, 1993, Bon 1992, Graf 1994). In North America, montane ectomycorrhizal fungi are less known, but the number of species collected with subalpine conifers (Overholts 1919, Kauffman 1921, Cázares 1992, Moser *et al.* 1995a, Moser and Ammirati 1996) and alpine *Salix* (Moser and McKnight 1987, Moser 1993) is increasing.

At higher elevations in the Front Range of the Canadian Rockies, the mature, subalpine forests of *Picea engelmannii* and *Abies lasiocarpa* begin to give way to the

low growing shrubs which dominate the alpine vegetation. At the ecotone, or zone of transition between these habitats, conifers form discrete, stunted, multi-stemmed islands or krummholz (Wardle 1968) resulting in a mosaic of alpine and subalpine vegetation.

Ecotones are potentially species rich, because of the unique combination of components from adjacent habitats (Risser 1995). Although the mycota of subalpine/alpine ecotones has received some attention in Europe (Moser 1967a, Gulden and Lange 1971, Moser 1982, Jacobsson 1984), the composition of ectomycorrhizal fungi at tree line in North America is essentially unknown.

This paper presents a list of ectomycorrhizal fungi collected at tree line, annotated with information on habitat, host associations and distributions. Taxonomic problems and morphological features are also discussed where pertinent. Many of the species identified represent new records for Alberta or Canada.

Materials and Methods

Sporocarps were collected between 2,000 and 2,200 m asl on the southeast slope of Mt. Tripoli, in the Nikanassin Range, Alberta (117^0 17'W, 52^0 52'N) and between 2,300 and 2,500 m asl on the southwest slope of Mt. Rae, Peter Lougheed Provincial Park (114^0 59'W, 50^0 36'N)(Fig.1). Sites were approx. 10 ha and covered by equal areas of the three vegetation types: (1) subalpine forest, co-dominated by *Picea engelmannii* Parry and *Abies lasiocarpa* (Hook.) Nutt. (at least 100 years old, based on increment cores), with closed canopies and sparse understory vegetation, (2) krummholz (stunted) *Picea* and *Abies*, forming islands separated by areas dominated by ericaceous species and the ectomycorrhizal species, *Salix barrattiana* Hook., *S. glauca* L., *S. arctica* Pallas, *Dryas octopetala* L., *D. integrifolia* M.Vahl, *Polygonum viviparum* L. and *Kobresia myosuroides* (Vill.) Fiori and Paol., and (3) alpine vegetation, similar to krummholz zone but without conifers. Because Mt. Tripoli is located 350 km northwest of Mt. Rae, it receives more precipitation (see below) and has lower temperatures, and, as a result, has a lower (300 m) tree line. Other differences include the occurrence of *Betula glandulosum* Michx. between krummholz conifers on Mt. Tripoli and scattered *Larix lyallii* Parl. in the subalpine forest and krummholz zone on Mt. Rae.

Soils are Dystric and Eutric Brunisols and Orthic and Orthic Humic Regosols (Trottier 1972, Mortimer 1978). Average monthly snowfall reaches 28 cm in June and 47 cm in September. During July and August the ground is relatively snow-free, and mean daily temperatures range from 6 to 10^0 C. Mean monthly precipitation during this period averages 97 mm at Mt. Tripoli and 72 mm at Mt. Rae (Environment Canada, Archives of Climatological Data).

Sites were visited monthly between June and Sept. 1994-97. Sporocarps of all fungi in putatively ectomycorrhizal genera were collected. Corticioid fungi were found by rolling logs and sporocarps of the hypogeous taxa collected were partially erumpent. Representative collections are deposited in the University of Alberta Cryptogamic Herbarium (ALTA). Microscopic examinations were made under high magnification in H_20, Melzer's reagent or sulphovanillin where appropriate. To determine spore size, 20-30 mature spores were measured in H_2O under oil.

Only published accounts that include habitat (host) data or important



Figure 1. Map of southern Alberta showing locations of collecting sites. Darkened areas represent montane habitats.

information on distributions are included in annotations. Herbarium records and foray lists are not included. Salient characters are described for taxa when discrepancies exist in the literature. Determination of new records for Alberta and western Canada was based (in part) on Ginns and Lefebvre (1993) and databases of Canadian macrofungi compiled by S.A. Redhead (Redhead 1997, Redhead unpublished data).

Results

A total of 81 species in 29 genera and 13 families were documented. Twenty two species are new to Canada, 35 to western Canada, and 40 to Alberta. Two genera are new records for Alberta. Species richness decreased with elevation: 65 species in 28 genera were collected in the subalpine forest, 41 species in 17 genera in the krummholz zone and 14 species in seven genera in the alpine zone. Taxa identified from the krummholz zone fell into three major assemblages with respect to host associations (Table 1): (1) 20 conifer associates, many with circumboreal distributions, likely to form ectomycorrhizae with krummholz *Abies*, *Picea* and (or) *Larix*, (2) 7 angiosperm associates, many with circumpolar and alpine distributions, likely to form ectomycorrhizae with dwarf *Salix, Betula* or *Dryas* spp. and (3) 14 species with little host specificity which are likely to form mycorrhizae with both the angiosperms and gymnosperms present at tree line.

Table 1. Habitats and probable hosts of taxa collected. Hosts are determined from literature review and location of sporocarps. + = literature report of symbiosis, ? = possible association.

	Probable host(s)					
Fungal species	*Betula*	*Dryas*	*Salix*	*Abies*	*Larix*	*Picea*
Alpine only						
Inocybe lanuginella		+				
Tomentella sublilacina		+	?			
Alpine and krummholz						
Cortinarius albonigrellus			+			
C. favrei			+			
C. galerinoides			+			
C. inops		+	+			
Inocybe lacera	+		+	?		+
Krummholz only						
Amanita vaginata	+		+			
Cortinarius clandestinus				?		?
C. evernius	+		+	?		+
C. hinnuleus		+	+			
Hydnellum suaveolens				?		+
Inocybe whitei				?		+
Lactarius pubescens	+					
Russula brevipes	+	+		+		+
R. torulosa						+
Krummholz and forest						
Boletopsis subsquamosa						+
Catathelasma imperiale				+		+
Cortinarius delibutus	+		+	?		+
C. fulminoides						+
C. multiformis				+		+
C. triformis				?		+
Cortinarius sp.				?		?
Dermocybe crocea	+		+			+
Hygrophorus chrysodon						+
H. korhonenii						+
H. speciosus					+	
Inocybe flocculosa	+		+	?		+
I. rimosa		+	+	+	+	+
Lactarius caespitosus				+		
L. deliciosus				+	+	+
L. luculentus				?		?
Russula integra				+		?
R. silvicola				+		?
Sarcodon sp.				?		?
Suillus aeruginascens					+	
Tricholoma saponaceum				+		+
T. virgatum				?		+

Fungal species	Probable host(s)					
	Betula	*Dryas*	*Salix*	*Abies*	*Larix*	*Picea*
Forest only						
Albatrellus flettii				?		?
Camarophyllus pratensis				?		?
Cortinarius brunneus						+
C. calochrous				?		+
C. chrysomallus						+
C. colus				?		+
C. crassus				?		+
C. dilutus						+
C. glaucopus				?		+
C. muscigenus				+		+
C. orichalceus				+		+
C. paragaudis						+
C. percomis						+
C. scandens				+		+
C. traganus				?		+
C. uraceus				+		+
C. venetus						+
C. zinziberatus				?		+
Gomphidius largus						+
Hebeloma insigne				?		?
Hydnellum caeruleum						+
Hydnotrya cubispora				?		+
Hydnum repandum				?		+
Hygrophorus erubescens						+
H. pudorinus				+		+
H. pustulatus				+		+
Hysterangium separabile				?		?
Lactarius alnicola				?		+
Pseudotomentella tristis				?		?
Rhizopogon rubescens				+	+	+
Sarcodon scabrosus				?		+
Suillus cavipes					+	
Thaxterogaster pingue				+		+
Thelephora caryophyllea				?		+
Tricholoma myomyces				?		+
T. vaccinum						+
Alpine and forest						
Amphinema byssoides	?	+	+	+	?	+
Cenococcum geophilum	+	+	+	+	+	+
Laccaria montana	+		+	+		+
Hebeloma crustuliniforme	+	+	+	+		+
H. cf. subfastigiatum		?	?	?		?
Inocybe dulcamara	+	+	+	?		?
Tomentella ellisii	?	+	?	?	?	?

Discussion

Vegetation at the alpine-subalpine ecotone in the Canadian Rockies is a mosaic of gymnosperms and low growing angiosperms and combines species from the subalpine forest with those from the alpine zone. Obligately ectomycorrhizal host genera include *Abies, Larix, Picea, Salix*, *Dryas* and *Betula*, as well as *Kobresia* and *Polygonum* to a lesser extent. This is twice the number of common ectotrophic host genera of either of the adjacent habitats and is comparable to the number found at lower elevations in Alberta (see Moss 1983). Only at ecotones, however, do they occur together in close proximity.

As the specificity of ectomycorrhizal fungi often operates at the level of host genus (Molina and Trappe 1982), we might expect the community of ectomycorrhizal fungi at tree line to reflect vegetational patterns and exhibit greater richness than in the adjacent habitats. Although ectomycorrhizal fungi at the ecotone included both associates of subalpine gymnosperms and alpine angiosperms (Table 1), richness was not positively correlated with that of the host plants, but instead decreased steadily with elevation. This pattern is likely due to the rich subalpine community combining with the more depauperate alpine community to give an intermediate richness at the ecotone. This is in contrast to the subalpine and alpine plant communities, which are more similar to each other in species number, and combine to give the relatively high plant richness seen at the ecotone.

The overall decrease in ectomycorrhizal sporocarps across tree line fits the general trends of decreasing species diversity (Chapin and Körner 1995) and decreasing fructification (Gardes and Dahlberg 1996) with elevation. Comparisons of ectomycorrhizae across tree line reveal a similar pattern with increasing elevation (Kernaghan and Currah, unpublished data) Lower richness in the alpine zone may be due to less amenable climatic and edaphic factors, particularly soil temperature and moisture (Peredo *et al.* 1983, Vogt *et al.* 1992), less carbon production from dwarf vegetation (Newman 1988) and (or) fewer ectomycorrhizal symbioses with angiosperms than with gymnosperms (Richardson 1970, Bieri *et al.* 1992).

Of the species collected, approximately 86% are also known from Europe, while only 14% appear to be endemic to North America (i.e. not found in the European literature). If we delineate North American varieties, the percentages are 84 and 16, respectively. The amount of overlap varies considerably among genera, however, with *Lactarii* representing mainly North American taxa, and *Russula* representing mainly species with circumboreal distributions. Among the *Cortinarii* collected, only *C. clandestinus* (and possibly the unidentified *Cortinarius*) is endemic to North America. This is in contrast to the 50% similarity between European and North American *Cortinarius* species estimated by M. Moser (pers. comm. 1994).

It is possible that the lack of endemic species in genera such as *Russula* and *Cortinarius* is a reflection of the lack of North American monographic treatments of these genera, and that in time, more endemics will be delineated. It is also possible that with more years of collecting, more endemic species may have been encountered. Arnolds (1992) estimates that with monthly visits, 80% of macrofungi would be seen in four years and Richardson (1970) continued to see new species in the fifth year of intensive monitoring of small plots. Our results appear similar, with 13 taxa (16%) being collected for the first time during the fourth year. Four of these, however, were

either hypogeous, secotioid or resupinate, and may have been simply overlooked in previous years.

It seems more likely however, that the low level of endemism found during this study is due to the dominance of *Picea* and *Salix* as ectomycorrhizal hosts at tree line. The occurrence of these genera throughout the taiga and arcto-alpine zones allows for the circumboreal or circumpolar distribution of many of the fungi collected. At lower elevations or latitudes, e.g. coastal British Columbia, higher levels of vascular plant endemism are encountered (Pojar 1993). With less floristic similarity to European forests, we would expect these regions to exhibit less overlap in species of ectomycorrhizal fungi.

Species richness of ectomycorrhizal fungi was not higher at the alpine/subalpine ecotone as might have been expected on the basis of ectotrophic host genera richness. The documentation of ectomycorrhizal fungi from this zone has however, extended many distributional ranges and revealed many new associations.

Species collected

Ascomycota

Cenococcum geophilum Fr.: Fr., Syst. Mycol. III: 66. 1830.

Common throughout the northern hemisphere. Mycorrhizal with all Pinaceae, Betulaceae, Fagaceae and Salicaceae, and some species of Rosaceae, Myrtaceae and Tiliaceae (Trappe 1962, 1964). Distinctive sclerotia and ectomycorrhizae are formed, but its precise position within the Ascomycota is unknown (Lobuglio *et al.* 1996). **Material examined***:* Collected repeatedly at both sites in all habitats (ALTA 10361).

Hydnotrya cubispora (Bessey & B. E. Thompson) Gilkey, Oregon State Monogr., Stud. Bot. 1: 23. 1939.

A widely distributed but uncommon North American conifer associate. Hypogeous under *Picea, Pinus, Pseudotsuga* and (or) *Tsuga* in northern and northwestern North America (Abbott and Currah 1997). Under *Tsuga, Abies, Betula* and *Acer* in Maine and Michigan (Bessey and Thompson 1920) and in the southeastern U.S. under *Tsuga* (Miller and Miller 1982). Also with introduced *Picea sitchensis* in the U.K. (Pegler *et al.* 1993). The genus *Hydnotrya* has not been reported previously from Alberta.

Material examined: Mt. Tripoli: 09 07 97 (ALTA 10373).

Basidiomycota

Amanitaceae

Amanita vaginata (Bull.:Fr.) Vittad., Tent. Mycol. Amanitarum Illustr. p. 30. 1826. *sensu lato*

A widespread and variable angiosperm associate. Common and widely distributed in North America and Europe in mixed coniferous and deciduous forests (Jenkins 1986), also well known from arctic (Lange 1955, Miller 1982, Petersen 1977) and alpine habitats (Favre 1955, Kühner and Lamoure 1986, Bas 1982), where it is associated with *Salix* and *Betula*. Many forms and varieties are recognized (see

Bas 1977), some of which are found with *Betula* near tree line (Lange and Skifte 1967, Gulden and Lange 1971, Jacobsson 1984, Watling 1987). Our material, collected near *Betula glandulosum*, *Salix barrattiana* and *Dryas octopetala*, has a fawn-coloured pileus drying to pale grey, up to 6 cm in diam., a white stipe up to 10 cm long and globose to subglobose spores, 8.7-12.0 x 8.7-12.6 μm, **Q** = 1.06.
Material examined: Mt. Tripoli: krummholz zone 08 05 94 (ALTA 10359); 08 30 97 (ALTA 10360). Devon, AB: S. Abbott 07 26 88 (UAMH 8576).

Boletaceae

Rhizopogon rubescens (Tul. & Tul.) Tul.& Tul., Giorn. Bot. Ital. 2: 58. 1844.

A common and widespread hypogeous conifer associate. Widely distributed in North America, usually the most common species of the genus in the north (Harrison and Smith 1968), also in Europe. Associated with Pinaceae, especially 2- and 3-needle pines (Miller 1986), but also with *Abies, Picea, Pseudotsuga, Tsuga* and *Quercus* (Molina and Trappe 1994). Ectomycorrhizae synthesized *in vitro* on *Pinus radiata, Pinus sylvestris* (Molina and Trappe 1994) and *Larix laricina* (Sampson and Fortin 1988). Although the spores of our material (7.0 - 9.9 x 3.0 - 3.7 (4.2)μm) are slightly smaller than those described by most authors, Smith and Zeller (1966) noted similar spores in some of their western collections.
Material examined: Mt. Rae: subalpine forest 07 21 94 (ALTA 10362); 07 25 95 (ALTA 10363); 09 29 95 (ALTA 10364); 08 16 97 (ALTA 10365). Smith Dorrian Valley, AB: 08 17 97 (ALTA 10366).

Suillus aeruginascens (Fr.) Snell, Lloydia 7: 25. 1944.

Circumboreal with *Larix* spp. Common in northern North America; Idaho, Michigan, New York, Oregon, and Québec with *L. laricina* and *L. occidentalis* (Pomerleau and Smith 1962), as well as Finland with *L. sibirica* (Heikkilä 1982) and the Austrian Alps with *L. decidua* (Moser 1982). Ectomycorrhizae have been synthesized on *Larix laricina* (Sampson and Fortin 1988) and *L. occidentalis*, *Pseudotsuga menziesii* and *Picea sitchensis* (Molina and Trappe 1982). Synonymous with *Fuscoboletinus aeruginascens* (see Kretzer *et al.*1996). Our material is the first report of this species with *Larix lyallii*.
Material examined: Mt. Rae: krummholz zone 08 4 95 (ALTA 10374); subalpine forest 08 04 95; 08 16 97 (ALTA 10375).

Suillus cavipes (Opat.) A. H. Sm. & Thiers, Contrib. Monogr. North Am. spec. *Suillus* 30. 1964.

Circumboreal, with *Larix* spp. Following the range of *L. laricina* and *L. occidentalis* (Smith and Thiers 1964, Thiers 1975) and with *L. sibirica* in Northern Finland (Heikkilä 1982) and *L. decidua* in the Alps (Moser 1982)(as *Boletinus cavipes*). This is the first report with *L. lyallii*.
Material examined: Mt. Rae: subalpine forest 08 16 97 (ALTA 10377).

Chaetoporellaceae

Amphinema byssoides (Pers.:Fr.) J. Erikss., Symb. Bot. Upsal. 16: 112. 1958.

Widely distributed in North America and Europe, fruiting on rotting wood of a

variety of angiosperms and gymnosperms (Eriksson and Ryvarden 1973, Ginns and Lefebvre 1993). Reported to form ectomycorrhizae with *Pinus strobus* (Fassi and De Vecchi 1962), *P. banksiana* Lamb. (Danielson 1984), *Picea glauca, P. pungens* (Danielson and Pruden 1989), *P. abies* (Weiss 1991) and *P. sitchensis* (Ingelby 1990), as well as with *Picea engelmannii*, *Abies lasiocarpa*, *Dryas octopetala* and *Salix* spp. (Kernaghan and Currah, unpublished data). Much of our material is from dead wood and prostrate branches of krummholz *Abies lasiocarpa.*
Material examined: Mt. Rae: alpine zone 09 19 97 (ALTA 10276); krummholz zone 08 16 95 (ALTA 10350). Mt. Tripoli: krummholz zone 08 05 94 (ALTA 10351); 08 05 94 (ALTA 10352); subalpine forest 08 30 97 (ALTA 10353).

Cortinariaceae

Cortinarius albonigrellus Favre, Rés. rech. sci. entr. Parc Nat. suisse, 5: 127. 1955. (subgenus *Telamonia*)

An arcto-alpine *Salix* associate. With dwarf alpine *Salix* in the Alps (Favre 1955, Lamoure 1977, Kühner and Lamoure 1986), Wyoming (Moser and McKnight 1987, Moser 1993), and the Greater Yellowstone Area (Moser *et al.* 1995b). Our material agrees with Horak's (1987) description of Favre's original material and with the description of Lamoure (1977). Pileus 1.5-2.0 cm, dark grey-black, glabrous. Stipe with persistent, peronate white veil; young lamellae and context pale yellow brown. Spores variable in size, 7.7-9.5 (11.0) x 4.0-5.6 μm, subcylindric to ellipsoid, finely verrucose, not all subcylindric as described by Horak (1987). Moser and McKnight (1987) describe *C. albonigrellus* from Wyoming with spores 8.8-12.3 x 5.3-7.0μm. Not previously reported from Canada.
Material examined: Mt. Rae: alpine zone 08 16 95 (ALTA 10138); krummholz zone 08 16 95 (ALTA 10139); 09 29 95 (ALTA 10140).

Cortinarius brunneus Fr., Epicr. Syst. Mycol., p. 298. 1838. (subgenus *Telamonia)*

With northern and coastal conifers and (rarely) with alpine vegetation. Known from central and northern Europe, in mixed boreal and montane coniferous forests, usually in oligotrophic *Picea* forests (Brandrud *et al.* 1992, Gulden *et al.* 1992, Arnold 1993). Also with subalpine *Betula* and *Salix* in northern Norway (Lange and Skifte 1967), *Pinus sylvestris* in northern Finland (Väre *et al.* 1996) and in the Austrian Alps up to timberline (Moser 1982). In North America, more common under conifers in the Pacific Northwest than elsewhere (Smith *et al.* 1979). In Washington, under second growth *Pseudotsuga menziesii* (Smith 1944) and in arctic tundra, northern Québec (Hutchison *et al.* 1988). Not previously reported from western Canada.
Material examined: Mt. Rae: subalpine forest 07 25 95 (ALTA 10145). Mt. Tripoli: subalpine forest 07 08 94 (ALTA 10146); 07 18 95 (ALTA 10147). Wildhay River AB: 08 06 95 (ALTA 10148).

Cortinarius calochrous (Pers.: Fr.) Fr., Epicr. Syst. Mycol., p. 267. 1838. subsp. *coniferarum* (M. M. Moser) Brandrud, Nord. J. Bot. **10**: 536. 1990. (subgenus *Phlegmacium*)

A circumboreal conifer associate. Known from European boreal and montane forests with *Abies*, *Picea* and (or) *Pinus* (Moser 1960, Brandrud *et al.*1990, 1994). In

North America, collections of *C. calochrous* in coniferous forests from Washington (Smith 1944, Stuntz 1981) are likely subsp. *coniferarum*. Also in the Greater Yellowstone Area (Moser *et al.* 1995b)(as *C. calochrous fo. caroli* Vel.) and the Canadian Rockies (Schalkwijk-Barendsen 1991). Mycorrhizae are described on *Picea engelmannii* (Kernaghan and Currah, unpublished data).

C. calochrous s.l. forms one of the most difficult taxonomic complexes in the subgenus *Phlegmacium* (Brandrud *et al.* 1990). Moser (1960) recognized var. *calochrous* from deciduous forests, var. *coniferarum* M. M. Moser (with larger spores) from coniferous forests and *fo. caroli* (also with larger spores and with violaceus stipe pigments), mainly from deciduous forests. Brandrud *et al.* (1992) elevated these varieties to subspecies and described subsp. *calochrous* from deciduous forests, subsp. *coniferarum* (M. M. Moser) Brandrud (with larger spores) from conifer forests, and varieties of each. Our material has consistently violaceus stipe apices and spores measuring 9.8-11.5 (13) x (5.6) 6-7 μm
Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10185). Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10186); 08 15 95 (ALTA 10187).

Cortinarius chrysomallus Lamoure, Trav. Sci. Parc Nat. Vanoise 8: 135. 1977. (subgenus *Telamonia*)

An alpine *Salix* associate, also with subalpine *Picea*. Collected with dwarf alpine *Salix* in the Alps (Lamoure 1977, Kühner and Lamoure 1986, Senn-Irlet 1993, Bon 1992, Graf 1994), Sweden and Norway (Lamoure 1977). In Wyoming, Montana, California and Washington with shrubby and dwarf *Salix* and *Picea engelmannii* (Moser and McKnight 1987, Moser 1993, Moser *et al.* 1995b). Our material agrees well with the description of Lamoure (1977). Pileus up to 3.5 cm, red brown, glabrous. Stipe dingy greyish, booted with bright yellow universal veil remnants, which turn red in 5% KOH. Young lamellae pale grey-brown with mauve tones. Context with distinct mauve tint. Spores (7.4-8.8 x 4.1-5.6 μm) are slightly smaller than reported by Lamoure (1977), but those depicted by Moser and McKnight (1987) show similar variation among collections. *Cortinarius chrysomallus* appears to be a predominantly alpine species but it has been collected at lower elevations (Lamoure 1977) and near *Picea* (Moser and McKnight 1987). Our material was collected under *Picea engelmannii* and *Abies lasiocarpa*. Not previously reported from Canada.
Material examined: Mt.Tripoli: subalpine forest 08 04 95 (ALTA 10234). Jasper National Park: 07 15 95 (ALTA 10149).

Cortinarius clandestinus Kauffman, North American Flora 10: 324. 1932 (subgenus *Leprocybe*)

A North American conifer associate. Associated with *Tsuga* and *Pseudotsuga* in Washington (Kauffman 1932, Stuntz 1981), also in Colorado, Idaho, Oregon, Michigan and New York (Kauffman 1925, Kauffman and Smith 1933). *C. cotoneus* is well known from European deciduous forests (Høiland 1980, Brandrud *et al.* 1992) and is morphologically similar to *C. clandestinus* (Stuntz 1981, Arora 1986). Reports of *C. cotoneus* from coniferous forests in North America (e.g. Smith 1939, 1944, Phillips 1991) may be based on collections of *C. clandestinus*. Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 08 16 97 (ALTA 10215).

Cortinarius colus Fr., Monographia, p. 102. 1851. (subgenus *Telamonia*)

A circumboreal *Picea* associate, also with *Pinus*. Associated with *Picea excelsa* in central Europe and Scandinavia (Moser 1965). Also in northern Finland, with *Pinus sylvestris* (Väre *et al.* 1996), and Germany, with conifers, especially *Picea* (Arnold 1993). Also collected in Washington (Smith 1944). Smith (1939) tentatively identified a *Telamonia* from northern California under *Abies* as *C. colus* (violet stipe apex and purple-red or vinaceous universal veil and spores 6-7 X 4-5 μm). Our material has a red brown, hygrophanous pileus, 2-4 cm in diam., pale grey-brown lamellae, greyish white stipe, 3-5 x 0.7-1.5 cm, white cortina and bright orange universal veil (purple in 5% KOH) forming persistent boot at stipe base. Spores (7.4) 7.8-9.0 x 4.7-5.8 μm. Not previously reported from Canada.

Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10150); 08 16 97 (ALTA 10151). Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10152).

Cortinarius crassus Fr., Epicr. Syst. Mycol., p. 257. 1831. *sensu* A. H. Sm.. (subgenus *Phlegmacium*)

A montane conifer associate. Well known from European conifer forests up to montane elevations, especially with *Picea* (Moser 1960, Henry 1984, Brandrud *et al.* 1992, Gulden *et al.* 1992), but also with *Pinus* and *Betula* in Finnish Lapland (Kallio and Kankainen 1964). In North America it is found in northern conifer forests and not uncommon in the western mountains, especially at higher elevations (Smith 1939, 1944, Smith *et al.* 1979, Stuntz 1981, Arora 1986), but differs from European material in lacking filiform cheilocystidia (see Moser 1960). Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10179); 09 07 97 (ALTA 10180).

Cortinarius delibutus Fr., Epicr. Syst. Mycol., p. 276. 1838. (subgenus *Myxacium*)

Associated with angiosperms (especially *Betula*) at higher elevations and latitudes and with conifers elsewhere. In northern Europe, with subalpine *Betula* and *Fagus*, and at higher elevations with dwarf *Salix* and *Betula nana* (Lange and Skifte 1967, Gulden and Lange 1971, Jacobsson 1984, Brandrud *et al.* 1994), also with *Picea* (Gulden *et al.* 1992, Brandrud *et al.* 1994, Bieri 1995) and *Pinus* (Favre 1960). Also known from Britain with *Fagus* and *Betula* (Orton 1955). In North America, it is reported from New York, Nova Scotia and Ontario in mixed woods (Pomerleau 1980) and in the west from Colorado with montane conifers (Kauffman 1921, 1932) and in the Greater Yellowstone Area (Moser *et al.* 1995b). Also with *Salix* and *Betula* in Alaskan tundra (Ammirati and Laursen 1982) and in Greenland (Lange 1957). Ectomycorrhizae have been synthesized *in vitro* between *C. delibutus* and *Tsuga heterophylla* (Kropp and Trappe 1982).

Cortinarius griseoluridus Kauff. is a similar species, also associated with *Picea* and *Abies* in the Rocky Mountains (Smith *et al.* 1979). It differs from *C. delibutus* in having violaceus tones to the pileus and larger spores (8-10 x 6.5-8 μm) (Smith *et al.* 1979). The spores of our material measure 7.5-8.5 x 6.5-7.5 μm.

Material examined: Mt. Rae: subalpine forest 08 12 94 (ALTA 10199); 08 16 95 (ALTA 10200); 07 25 95 (ALTA 10201); 08 16 97 (ALTA 10202); 09 19 97 (ALTA 10203). Mt.Tripoli: krummholz zone 08 04 95 (ALTA 10204); 08 15 95 (ALTA

10205); subalpine forest 08 4 95 (ALTA 10206); 08 15 95 (ALTA 10207); 09 11 94 (ALTA 10208). Bruderheim, AB: E. Nagasawa 1982 (CFB 21211).

Cortinarius dilutus Fr., Epicr. Syst. Mycol. p. 305. 1838. (subgenus *Telamonia*)

A northern associate of *Picea*. In central Europe and throughout the Alps, primarily with *Picea* but also in mixed woods, especially in swampy areas (Moser 1984, Arnold 1993). Also in Fennoscandia, in coniferous or *Betula* forests (Hansen and Knudsen 1992). With montane conifers, Colorado, Washington, Oregon and Adirondaks (Kauffman 1921, 1932, Smith 1944) and with *Picea engelmannii* in the Greater Yellowstone area (Moser *et al.* 1995b). In Greenland with *Salix* (Lange 1957) (as *C. saturninus*) and Nova Scotia with *Picea* (Gourley 1983) or *Fagus* and *Abies* (Smith and Wehmeyer 1936) and *Picea* in northern Québec (Hutchison *et al.* 1988) (as *C. saturatus*). Synonymous with *C. saturatus* Lge. *fide* Moser (1984). Not previously reported from western Canada.

Material examined: Mt. Tripoli: subalpine forest 08 14 95 (ALTA 10153).

Cortinarius evernius (Fr.:Fr.) Fr., Epicr. Syst. Mycol., p. 294. 1838. (subgenus *Telamonia*)

Circumboreal, generally with *Picea* up to subalpine elevations, often in hygric areas. In central Europe with *Picea* (Gulden *et al.* 1992, Arnold 1993) and in Fennoscandia, with *Picea*, subalpine *Betula* or mixed *Picea* and *Fagus* (Brandrud *et al.* 1990, Kallio and Kankainen 1966, Moser 1967b). In northern U.S. and Canada with conifers in wet or mossy habitats, not common (Kauffman 1932, Smith *et al.* 1979). Reported from Washington with *Abies lasiocarpa, A. amabilis* and *Tsuga heterophylla* (Moser and Ammirati 1996). Not previously reported from western Canada.

Material examined: Mt. Rae: krummholz zone 09 29 95 (ALTA 10154); 09 19 97 (ALTA 10155).

Cortinarius favrei M. M. Moser ex Henderson, Notes Roy. Bot. Gard. Edinb., 22: 593. 1958. (subgenus *Myxacium*)

A circumpolar and alpine *Salix* associate. With dwarf alpine *Salix* spp. in Norway (including Svalbard) (Ohenoja 1971, Gulden *et al.* 1985, Gulden and Lange 1971), the Alps (Favre 1955, Senn-Irlet 1988, 1993, Graf 1994, Kühner and Lamoure 1986), Scotland (Watling 1987) and Greenland (Petersen 1977). Also reported with *Betula* in Swedish alpine heaths (Jacobsson 1984). With dwarf alpine *Salix* in North America; Wyoming (Moser and McKnight 1987, Moser 1993), Alaska (Kobayashi *et al.* 1967, Ammirati and Laursen 1982), and the Greater Yellowstone Area (Moser *et al.* 1995b). Synonymous with *C. alpinus* Boud. *fide* Ohenoja (1971). Not previously reported from Canada.

Material examined: Mt. Tripoli: alpine zone 09 07 97 (ALTA 10209); krummholz zone 08 15 95 (ALTA 10210); 09 11 95 (ALTA 10211).

Cortinarius fulminoides (M. M. Moser) M. M. Moser, in Gams, Kleine Kryptogamenflora, II, b/2, Basidiomyceten II, Ed. 3, p. 284. 1967. (subgenus *Phlegmacium*)

A montane *Picea* associate. Reported from the Austrian Alps with *Picea*

excelsa (Moser 1960). Our material fits Moser's (1960) description closely. Pileus fulvus-orange, up to 8 cm in diam., slightly fibrillose towards margin, spotting green, reddening in 5% KOH. Young lamellae pallid grey brown. Cortina white, scant. Stipe white, up to 5 x 2 cm., with a bulbous base. Context thick, yellowish, localized areas becoming green. Spores amygdaliform (7.6) 8.0-9.0 x 5-5.5 (5.9) μm. The context of our material did not become orange-brown in KOH as in Moser's description. A previous Canadian report by Currah *et al.* (1989) is based on misidentified material (UAMH M0457, M0487).
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 10181); subalpine forest 09 11 94 (ALTA 10182).

Cortinarius galerinoides Lamoure, Trav. Sci. Parc Nat. Vanoise, 8: 133. 1977. (subgenus *Telamonia*)

A circumpolar and alpine *Salix* associate. Reported from the French Alps (Kühner and Lamoure 1986, Lamoure 1977) with dwarf alpine *Salix* and from Wyoming with shrubby alpine *Salix* (Moser 1993). Our material fits the description of Moser (1993). Sporocarps resembling *Galerina* in habit, pileus up to 1.2 cm, red brown, hygrophanous, black in 5% KOH. Stipe more or less concolorous with pileus. Lamellae rust brown. Cortina white, very scant. Spores ellipsoid (7.0) 7.6-10.3 x (4.2) 4.6-5.5 (5.9) μm. Not previously reported from Canada.
Material examined: Mt. Tripoli: alpine zone 08 15 95 (ALTA 10156); krummholz zone 08 15 95 (ALTA 10157).

Cortinarius glaucopus Fr., Epicr. Syst. Mycol., p. 264. 1838. (subgenus *Phlegmacium*)

A common conifer associate. Throughout Europe with *Picea* and *Pinus* up to 1900 m (Moser 1960), rarely in deciduous woods (Brandrud *et al.* 1994). In Britain with conifers (Orton 1955) and in the eastern United States with deciduous trees (Kauffman 1932). In western North America it is one of the most common *Cortinarii* along the coast (Smith 1939, Stuntz 1981), often in large troops under *Pseudotsuga menziesii* (Smith 1939) or *Abies* and *Picea* (Smith *et al.* 1979). Also with *Picea* in the Rockies (Arora 1986, Currah *et al.* 1989). Moser (1960) recognized *C. glaucopus* var. *acyaneum* M. M. Moser, which lacks blue pigments, and var. *olivaceum* M. M. Moser, with strong green tones towards the centre of the pileus. Smith (1939) reported a green form from California as did Stuntz (1981) from the Pacific Northwest. Our material corresponds to the typical variety, lacking green tones.
Material examined: Mt. Tripoli: 08 30 97 (ALTA 10183); 09 07 97 (ALTA 10184).

Cortinarius hinnuleus (Sowerby: Fr.) Fr., Epicr. Syst. Mycol., p. 296. 1838. var. *favreanus* Bon, Doc. Mycol. 22: 52. 1992. (subgenus *Telamonia*)

Circumpolar and alpine. *Cortinarius hinnuleus s.l.* is common in Europe (Brandrud *et al.* 1990, Arnold 1993) and North America (Kauffman 1932, Pomerleau 1980) with woody angiosperms including *Quercus, Betula* and *Fagus* as well as with conifers. *Cortinarius hinnuleus* var. *favreanus* is a circumpolar and alpine associate of *Salix* and *Dryas*, known from the Swiss and French Alps with dwarf *Salix* or *Dryas* (Favre 1955, Kühner and Lamoure 1986, Lamoure 1977, Senn-Irlet 1988), Greenland with *Salix* (Lange 1957) and Wyoming with alpine *Salix* (Moser 1993). Our material

agrees well with the description of Moser (1993). Pileus hygrophanous to yellow-brown, up to 3.5 cm in diam., lamellae subdistant, pale ochre, stipe yellow brown, partial veil whitish to pale ochre, spores 8.3-9.7 (-10.4) x (4.8) 5.2-6.4 μm, smell slightly earthy, gregarious with *Salix* spp. Synonymous with *C. hinnuleus* var. *gracilis* R. Maire *fide* Moser (1993). Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 07 25 95 (ALTA 10158); 08 16 95 (ALTA 10159); 07 08 94 (ALTA 10160).

Cortinarius inops Favre, Rés. rech. sci. entr. Parc Nat. suisse 5: 136. 1955. *sensu* Møller. (subgenus *Telamonia*)

Circumpolar and alpine. With dwarf alpine *Salix* or *Dryas*; in the Swiss, French and Italian Alps (Kühner and Lamoure 1986, Lamoure 1978, Favre 1955), Scandinavia (Lamoure 1978, Hansen and Knudsen 1992), Faeröe islands (Möller 1945), Greenland (Lange 1957), Iceland (Larsen 1932), Wyoming (Moser 1993) and the Greater Yellowstone Area (Moser *et al.* 1995b). Our material agrees well with Möller's (1945) description (as *C. pusillus*). Pileus up to 2 cm in diam., convex with an involute margin and prominent umbo, dark brown, radially fibrillose, hygrophanous, sometimes splitting to reveal pallid context. Lamellae ochre to cinnamon. Stipe up to 2.5 cm long, hollow, ochre-brown and covered with white fibrils, sometimes with a pinkish cast or pinkish basal hyphae. Spores 6.8-9.0 x 5.0-6.5 μm, broadly elliptic to ovoid, coarsely verrucose. The purple-blue tints described by Möller (1945) were not observed. Although short clavate cheilocystidia are described by Favre (1955), Lamoure (1977) and Moser (1993), the sterile cells along the edge of the lamellae in our material are more or less undifferentiated, as described by Möller (1945). Synonymous with *C. pusillus fide* Moser (1993). Not previously reported in Canada.
Material examined: Mt. Rae: alpine zone 07 25 95 (ALTA 10161). Mt. Tripoli: krummholz zone 07 8 94 (ALTA 10162); 07 18 95 (ALTA 10163).

Cortinarius multiformis (Fr.) Fr., Epicr. Syst. Mycol., p. 263. 1838. var. *coniferarum* (M. M. Moser) Nezdoimïnogo, Shlyapochnye Griby SSSR Rod *Cortinarius* Fr.: 39. 1983. (subgenus *Phlegmacium*)

Circumboreal. *C. multiformis s.l.* occurs in Europe throughout the range of *Picea* (Brandrud *et al.* 1990), also with *Betula*, *Salix* and *Pinus* in Finnish Lapland (Kallio and Kankainen 1966) and Greenland with *Salix* (Lange 1957). Also common and widely distributed under conifers, in the Rocky Mountains, northern U.S. and Canada (Kauffman 1932, Smith *et al.* 1979); under *Abies* in Washington (Smith 1939) and *Picea* and *Pinus* in the Canadian Rockies (Schalkwijk 1991). Moser (1960) recognized *C. multiformis* var. *coniferarum* (as *Phlegmacium multiforme* var. *coniferarum*), with *Picea excelsa* and *Pinus,* up to subalpine elevations in Germany, and var. *multiformis* with *Fagus* throughout Europe, with the exception of the Alps. He also refers to material from the Greater Yellowstone Area as *C. multiformis* var. *coniferarum* (Moser *et al.* 1995b). Our material fits the descriptions of Moser (1960) and Smith *et al.* (1979).
Material examined: Mt. Rae: krummholz zone 09 19 97 (ALTA 10189); subalpine forest 08 16 97 (ALTA 10190); 09 19 97 (ALTA 10191). Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10192).

Cortinarius muscigenus Peck, Ann. Rep. N.Y. State Mus. 41: 71. 1888. (subgenus *Myxacium*)

A circumboreal conifer associate. Known from northern Europe in nutrient-poor *Picea* forests (Brandrud *et al.* 1990, Hansen and Knudsen 1992). Also in coniferous forests in New York, New England and New Jersey (Kauffman 1932) and Washington (Smith 1944). Under *Abies*, New York (Smith *et al.* 1979). Synonymous with *C. cylindripes* Kauffman *fide* Bendiksen *et al.* (1992). *C. muscigenus* may also be conspecific with *C. collinitus* Fr. (Bendiksen *et al.* 1992, Brandrud *et al.* 1990), but nomenclatural problems make the interpretation of *C. collinitus* difficult. Not previously reported from Canada.

Material examined: Mt. Rae: subalpine forest 08 16 97 (ALTA 10212); 09 19 97 (ALTA 10213). Smith Dorrian Valley, Kananaskis: 08 17 97 (ALTA 10214).

Cortinarius orichalceus Fr., Epicr. Syst. Mycol., p. 267. 1838. var. *olympianus* A. H. Smith, Lloydia 7: 184. 1944. (subgenus *Phlegmacium*)

A montane conifer associate. *C. orichalceus s.l.* is associated with *Picea excelsa* in Europe (Moser 1960), in mountainous areas of Britain with conifers or *Fagus* (Orton 1955), in western North American mountains with *Picea engelmannii* and *Abies lasiocarpa* (Kauffman 1921, 1932, Smith 1939, 1944), and in Nova Scotia (Gourley 1983). Known from the Greater Yellowstone Area (Moser *et al.* 1995b). Smith (1944) recognized var. *olympianus* A. H. Smith and var. *xanthocephalus* A. H. Smith from Washington.

Our material has a brick red-brown pileus with a greenish margin. Gills at first yellow green, quickly turning blue after collection. Stipe white with green tones and a reddening, marginate base. Context white with blue, then green, suffusing pigments. Cortina white. In one collection (ALTA 10193), green pigment suffused throughout the sporocarps (including gills and cortina) after collection. Sporocarps drying purple. All parts, including pileus, greenish-yellow in 5% KOH. Spores amygdaliform to citriniform, 9.7-11.6 x 5.5-7.0 (-7.4) μm. This seems closest to var. *olympianus* A. H. Smith, which is also the variety collected in Colorado by Kauffman (Smith 1944). *C. orichalceus s.l.* has not been reported previously in western Canada.

Material examined: Mt. Rae: subalpine forest 09 16 95 (ALTA 10193); 09 19 97 (ALTA 10194). North Kananaskis Pass, AB: 09 21 97 (ALTA 10195).

Cortinarius paragaudis Fr., Monographia, p. 79. 1851. subsp. *oenochelis* Lindstr., *Cortin.*, Fl. Photogr. 2: 33. 1992. (subgenus *Telamonia*)

A northern *Picea* and *Pinus* associate. *C. paragaudis s.l.* is known from northern Finland with *Pinus sylvestris* (Väre *et al.* 1996), Sweden, mainly with *Picea* (Soop 1990) but also *Pinus* (Brandrud *et al.* 1990, Soop 1993), Norway in oligotrophic *Picea* forests (Gulden *et al.*1992), alpine Scandinavia with *Picea excelsa* and (or) *Pinus sylvestris* (Moser 1965) and in the Pacific Northwest and Rocky Mountains (J. Ammirati pers. com. 1998). Moser (1965) separated *C. paragaudis* from the closely related *C. haematochalis* (Bull.: Fr.) Fr. in central Europe and Scandinavia mainly on the basis of spore size and shape. Brandrud *et al.* (1992) further separated *C. paragaudis* from Swedish spruce forests into subsp. *paragaudis* from lowland Sweden, and subsp. *oenochelis* Linst. from northern montane Sweden, with larger spores. Our material fits the descriptions of subsp. *oenochelis* of Soop

(1990) and Brandrud *et al.* (1992). Pileus dark red brown, convex, then almost plane with a low umbo and involute margin, up to 6.0 cm in diam., slightly hygrophanous. Lamellae pale grey-brown. Stipe clavate, up to 7 cm long, tapering towards a base of up to 1.5 cm. Universal veil forming greyish-pink belts on stipe, which turn purple in 5% KOH (see Soop 1992). Cortina white. Spores (8.2) 8.8-9.6 (10.0) x 5.7-7.0 μm, Q= 1.25-1.76, **Q**=1.44. *C. paragaudis s.l.* has not previously been reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10164); 08 15 95 (ALTA 10165). Wildhay River AB: 08 06 95 (ALTA 10166).

Cortinarius percomis Fr., Epicr. Syst. Mycol., p. 260. 1838. (subgenus *Phlegmacium*)

A *Picea* associate. In central and northern Europe, in mixed, boreal and montane conifer forests, mainly with *Picea* on calcareous soils (Moser 1960, 1983, Brandrud *et al.* 1994). In Washington and Colorado, in montane *Picea*, *Abies* and *Tsuga* forests (Kauffman 1921, 1932) and Oregon and California under *Picea* (Smith 1939). Associated with *Picea abies* (Trappe 1962). Not previously reported from Canada.

Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10196); 09 19 97 (ALTA 10197). Mt Tripoli: 09 07 97 (ALTA 10198).

Cortinarius scandens Fr., Epicr. Syst. Mycol., p. 312. 1838. *sensu* M. M. Moser. (subgenus *Telamonia*)

A widespread generalist. Found in damp coniferous woods and alder bogs in Europe (Moser 1983), with *Picea* or other conifers in California and Washington (Smith 1939, 1944), montane conifers in Colorado (Kauffmann 1921) and in deciduous and coniferous woods from New York (Adirondaks) to Michigan (Kauffman 1932). Associated with *Pinus sylvestris* or *Salix glauca* (Trappe 1962). Arnold (1993) considers *C. obtusus* Fr. a synonym. *C. obtusus* is widely distributed and has a broad host range (Molina *et al.* 1992); found in northern and central Europe under *Picea*, *Pinus, Fagus, Salix* and *Betula* into the alpine zone (Brandrud *et al.* 1994, Gulden *et al.* 1992, Moser 1982, Scherfose 1990), but especially with *Picea* (Arnold 1993). Also with *Salix* in the U.K. (Watling 1981) and Greenland (Lange 1957, Petersen 1977). In Alaska with *Salix* and *Betula nana* (Ammirati and Laursen 1982)(as *C.* aff. *obtusus*) and in the Greater Yellowstone Area (Moser *et al.* 1995b). Smith (1939) recognized *C. obtusus* under *Pinus* and *C. scandens* under *Picea* in California. The ectomycorrhizae of *C. obtusus* have been described on *Picea abies* (Agerer 1987a).

C. scandens has been separated from *C. obtusus* by smaller spores and less robust habit (Moser 1983). Arnold (1993) gives a spore size of (6.5) 8-10 x 5-6 μm for *C. obtusus* Fr. (= *C. scandens* Fr.). Spore size in our material is (6.3) 6.8-7.4 (8.4) x (4.4) 5.0-5.6 μm, and is therefore closer to *C. scandens* described by Kauffman (1932), Moser (1983) and Dähnke (1993). Not previously reported from western Canada.

Material examined: Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10167). Mt. Rae: 09 19 97 (ALTA 10168).

Cortinarius traganus (Fr.:Fr) Fr., Epicr. Syst. Mycol., p. 281. 1838. (subgenus *Sereciocybe*)

A common conifer associate. Frequent and widespread in European coniferous forests under both *Picea* and *Pinus* (Brandrud *et al.* 1994), Norway with *Picea abies* (Gulden *et al.* 1992) and northern Finland with *Pinus sylvestris* (Väre *et al.* 1996). Not uncommon in old growth conifer forests in the Pacific Northwest (Smith *et al.* 1979) and frequent under *Abies* and *Picea* in Nova Scotia (Smith and Wehmeyer 1936). Also known from mixed conifer-deciduous forests (Ammirati *et al.* 1995)
Material examined: Mt. Rae: subalpine forest 08 16 97 (ALTA 10224); 09 19 97 (ALTA 10225).

Cortinarius triformis Fr., Hymen. Eur., p. 382. 1874. (subgenus *Telamonia*)

Associated with conifers, especially *Picea*. In central and northern Europe with *Picea* (Hansen and Knudsen 1992, Arnold 1993); to tree line in the Austrian Alps with *Picea*, *Pinus,* and *Larix* (Moser 1982). Also in California with *Quercus* (Arora 1986), in the Greater Yellowstone Area (Moser *et al.* 1995b) and in the Rocky Mountain Foothills with *Picea* (Currah *et al.* 1989). Arnold (1993) proposes moving conifer-associated material to *C. fusco-pallens* (Fr.) N. Arnold, and reserving the name *C. triformis* Fr. for deciduous forest material, although they are morphologically similar. Our material agrees well with Arnold's (1993) description of *C. fusco-pallens*, but the epithet *triformis* has been retained until we have a better understanding of North American *Telamonia*. Pileus 2.5-6.0 cm in diam., dark red brown, strongly hygrophanous, often with a fatty texture. Lamellae pale grey-brown. Stipe whitish with a bulbous base. Universal veil white, forming a thin, peronate sheath on the stipe. Context dingy white to pale brown. Spores ellipsoid, 8.0-9.5 x (5.0) 5.4-6.3 μm. Sporocarps often caespitose. The faint blue tint at stipe apex described by Arnold (1993) was not noted. Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10169); 09 29 95 (ALTA 10170); 08 16 97 (ALTA 10171); subalpine forest 09 14 96 (ALTA 10172). Mt. Tripoli: subalpine forest 08 4 95 (ALTA 10173); 08 15 95 (ALTA 10174); 08 16 97 (ALTA 10175); 09 07 97 (ALTA 10176). Rocky-Clearwater Forest AB: S. Abbott, 08 20 87 (UAMH M0487).

Cortinarius uraceus Fr., Epicr. Syst. Mycol., p. 309. 1838. (Subgenus *Telamonia*)

A northern conifer associate. Widespread in European coniferous and mixed woods, often with *Picea*, also *Abies*, *Quercus,* and *Fagus* (Arnold 1993, Brandrud *et al.* 1994) or *Pinus* (Kallio and Kankainen 1966, Arnolds *et al.* 1995). Found near timberline in the Austrian (Moser 1982) and Swiss Alps with *Picea* (Favre 1960). Also with montane conifers in Colorado and the Adirondacks (Kauffman 1921, 1932), Washington (Smith 1944) and the Greater Yellowstone Area (Moser *et al.* 1995b). Also in Wyoming, with alpine *Salix* and *Picea engelmannii* (Moser and McKnight 1987) and boreal (Hutchison *et al.* 1988) and southern Québec (Pomerleau 1980). Not previously reported from western Canada.
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10177). Mt. Rae: subalpine forest 08 16 95 (ALTA 10178).

Cortinarius venetus (Fr.) Fr., Hymen. Eur., p. 374. 1874. var. *montanus* M. M. Moser, Zeitschr. F. Pilzk. 36: 43. 1970. (subgenus *Leprocybe*)

A *Picea* associate, normally in montane to subalpine habitats (Moser 1983). Associated with *Picea* in the Alps (Moser 1970), Fennoscandia (Høiland 1980, Hansen and Knudsen 1992) and the Netherlands (Arnolds *et al.* 1995). Also in the Greater Yellowstone Area (Moser *et al.* 1995b). *C. venetus* var. *montanus* differs from var. *venetus* in its association with *Fagus,* and in having a darker green pileus (Moser 1970). Our material has bright yellow fluorescence under UV (especially the stipe base), small clavate cheilocystidia and subglobose spores [5.5-7.5 x 4.5-6.0 (6.5) μm, **Q** = 1.20]. Ectomycorrhizae are described on *Picea abies* by Agerer (1987b). Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 07 25 95 (ALTA 10216); 09 07 97 (ALTA 10217).

Cortinarius zinziberatus (Fr.) Fr., Hymen. Eur., p. 392. 1874. (subgenus *Leprocybe*)

A montane conifer associate. Known from central Europe and the Italian Alps in montane and subalpine forests with *Picea* or with *Fagus* (Moser 1969) and Fennoscandia with *Picea*, fruiting early in the season (Høiland 1980, Hansen and Knudsen 1992). Known from the Greater Yellowstone Area (Moser *et al.* 1995b). *Cortinarius ahsii* McKnight, found with conifers in the central Rockies, is likely *C. zinziberatus* (J. Ammirati pers. comm.1997). Our material fits the descriptions of Moser (1969) and McKnight (1975). Pileus yellow-brown, 2-5 cm in diam. Stipe pale brown, up to 6 cm. Lamellae ± concolorous with pileus. Cortina greenish-yellow becoming orange-red in 5% KOH. Spores ellipsoid to amygdaliform, 6.5-9.5 x 4.5-5.5 μm. Tissue of all collections fluorescing bright greenish-yellow in UV (especially velar tissue, stipe base and basal hyphae). Fruiting soon after snow melt. The violet tint to the young gills and stipe base as described in Høiland (1980) was not observed. Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 07 18 95 (ALTA 10218); 08 04 95 (ALTA 10219); 09 07 97 (ALTA 10220). Mt. Rae: subalpine forest 07 25 95 (ALTA 10221); 08 16 95 (ALTA 10222); 07 27 96 (ALTA 10223).

***Cortinarius* sp.** (subgenus *Sericeocybe*)

Pileus up to 4 cm in diam., pallid cream to off-white, drying to pale tan, convex, glabrous with faint pale tan fibrils toward margin, merely darkening in 5% KOH. Lamellae pallid tan to dingy white. Stipe up to 6 x 2 cm with base enlarged up to 3 cm, concolorous with pileus. Context whitish, no reaction in 5% KOH. Universal veil white, heavy, forming a boot at stipe base. Cortina white. Spores amygdaliform, strongly verrucose, especially at apex, 9.1-10.8 x 5.7-6.8 μm. This *Cortinarius* seems best placed in the subgenus *Sericeocybe* Orton, based on pileus texture, pallid colours and KOH reaction of the pileipellis. It seems close to *C. traganus,* but has larger spores and lacks the violet colours and unpleasant odour.

Moser (in Singer 1986) states that members of the subgenus *Sericeocybe* may be eventually placed into either *Phlegmacium* or *Telamonia*, and Brandrud *et al.* (1990-94) already treat *Sericeocybe* as a section of *Telamonia*. Once the subgeneric classification of *Cortinarius* has stabilized, this species may be best placed in *Telamonia*.

Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10226); 08 15 97 (ALTA 10227); krummholz zone 08 16 95 (ALTA 10228).

Dermocybe crocea (Schaeff.:Fr.) M. M. Moser, Schweiz. Z. Pilzk. 52: 98. 1974. *sensu lato*.

Circumpolar, with conifers or arcto-alpine vegetation. Common in Fennoscandia with lowland and boreal *Picea* and *Pinus* and in low and middle arctic regions with *Betula nana* (Høiland 1984, Brandrud *et al.* 1992, Väre *et al.* 1996). Also in Iceland (Lange 1955)(as *Cortinarius cinnamomeus*), the Faeröes (Møller 1945)(as *C. malicorius* according to Høiland 1984), Scotland with montane vegetation (Watling 1987), the Swiss Alps with dwarf alpine *Salix* (Graf 1994), and the Rocky Mountain Foothills, with *Pinus contorta* and *Picea glauca* (Currah *et al.* 1989). Mycorrhizae have been described on *Pinus sylvestris* by Uhl and Agerer (1987).

Our material [spores 6.4-9.1 x 4.2-5.6 (6.4) μm] agrees well with the concept of Høiland (1984), but Moser (1974) describes smaller sporocarps and smaller spores. North American material appears to constitute an unresolved complex which includes *Dermocybe incognitis* Ammirati and A. H. Sm. and its western variants (J. Ammirati pers. comm. 1997).

Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10229); 07 25 95 (ALTA 10230); subalpine forest 08 16 97 (ALTA 10231). Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10232); 08 15 95 (ALTA 10233). Rocky Clearwater Forest AB: R. Currah 08 6 86 (UAMH M0131); S. Abbott 08 20 87 (UAMH M0493); 09 02 87 (UAMH M0497).

Hebeloma crustuliniforme (Bull.) Quél., Flor. mycol. Fr., p. 92. 1888. *sensu lato*.

Cosmopolitan and common with a wide range of coniferous and angiosperm hosts. Often associated with *Corylus* and *Fraxinus* in Europe (Hacskaylo and Bruchet 1972, Bruchet 1970). Ectomycorrhizae have been described on *Abies* (Acsai and Largent 1983) and synthesized *in vitro* on *Picea abies* (Brunner *et al.* 1991), *Pinus virginiana* (Hacskaylo and Bruchet 1972) and *Populus tremuloides* (Godbout and Fortin 1985). *H. crustuliniforme* is a highly variable and poorly understood taxon.

Material examined: Mt. Tripoli: alpine zone 09 07 97 (ALTA 10279); krummholz zone 09 11 94 (ALTA 10280); 09 07 97 (ALTA 10281). Mt. Rae: subalpine forest 08 16 97 (ALTA 10282); 09 19 97 (ALTA 10283).

Hebeloma insigne A. H. Sm., V. S. Evenson & D. H., Veiled species of *Hebeloma* in western U.S., p 132. 1983.

A montane conifer associate. In *Picea, Abies* and *Pinus* forests in Colorado (Smith *et al.* 1983) and under conifers and *Populus* in Colorado and New Mexico (Arora 1986). *H. insigne* is similar in appearance to *H. sinapizans* (Paul.: Fr.) Gillet, but can be distinguished by dextrinoid spores, vinaceous brown pileus and positive $FeSO_4$ reaction on stipe base (Smith *et al.* 1983). Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10284).

Hebeloma cf. subfastigiatum A. H. Sm., V. S. Evenson & D. H. Mitchel, Veiled species of *Hebeloma* in western U.S., p 180. 1983.

Pileus up to 3 cm in diam., red-brown, fading to pale tan, convex, glabrous except for faint brown veil remnants on margin, no reaction in 5% KOH. Lamellae ± concolorous with pileus. Stipe up to 4 x 0.5 cm, fibrous, yellow-brown, with brown velar remains toward the apex, base green in $FeSO_4$. Context buff, taste and smell raphinaceous. Cortina brownish. Spores inequilateral, slightly roughened, slowly dextrinoid, 9.7-12.4 (13) x (5.1) 5.8-7.1 (8.2) μm, Cheilocystidia abundant, fusoid-ventricose to lageniform, some with extended necks (40-75 x 5.5-7.0 μm, up to 12 μm at base), similar to those of *H. fastibile* (Pers.:Fr.) Kumm. Although Smith *et al.* (1983) describe many *Picea*-specific veiled *Hebelomas* from high elevation western forests, our material seems closest to *H. subfastigiatum*, described from a recently burned-over hardwood forest in Michigan.
Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10285); 08 14 95 (ALTA 10286); Mt. Tripoli: alpine zone 09 07 97 (ALTA 10287).

Inocybe dulcamara (Alb.& Schwein.) Kumm., Führ. Pilzk., p 79. 1871. *sensu lato*.

Widespread and common in arctic and alpine habitats, generally with dwarf *Salix* and *Dryas*, or with *Betula* or *Populus* at lower elevations or latitudes. Reported from the French, Swiss and Austrian Alps (Favre 1955, Horak 1960, Senn-Irlet 1988, 1993), Fennoscandia (Lange and Skifte 1967, Jacobsson 1984), the Netherlands (Arnolds *et al.* 1995), Greenland (Petersen 1977), the Faeröes (Möller 1945) Iceland (Larsen 1932), Scotland (Watling 1981, 1987), Washington with subalpine *Abies* and *Pinus* (Stuntz 1947), California (Nishida 1989) and in Canada in arcto-alpine or boreal habitats (Malloch 1973, Miller 1987, Hutchison *et al.* 1988). Favre (1955) recognized six forms of *I. dulcamara,* which should be regarded as a species complex. Our material fits the description of Malloch (1973). Pileus up to 4.5 cm in diam., ochraceous, finely fibrillose. Stipe up to 4 cm, concolorous with pileus or paler, pruinose at apex, becoming hollow, without an abrupt bulb but base may be slightly enlarged. Cortina whitish. Lamellae ochraceous, yellow marginate. Context dingy buff, without distinctive smell. Spores smooth, phaseoliform to broadly ellipsoid, (8.0) 9.0-10.8 x 5.0-6.7 μm. Cheilocystidia numerous, clavate to pyriform, 15-30 x 8-20 μm. Pleurocystidia absent.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10288). Mt. Tripoli: alpine zone 08 04 95 (ALTA 10311); krummholz zone 08 04 95 (ALTA 10312); subalpine forest 09 11 94 (ALTA 10313); 08 15 95 (ALTA 10314); 08 30 97 (ALTA 10315); 09 07 97 (ALTA 10316).

Inocybe flocculosa (Berk.) Sacc., Syll. Fung. 5: 768. 1887.

A cosmopolitan generalist. Widespread in Europe and North America, associated with *Betula, Salix, Populus, Alnus, Quercus, Fagus, Picea* and *Pinus* (Kuyper 1986). Known from the Swiss Alps, with dwarf alpine *Salix* (Favre 1955), and from Greenland with *Betula*. Also with conifers in California (Nishida 1989) and in subalpine forests of mixed *Picea, Abies* and *Pinus* in Washington (Stuntz 1947) and Colorado (Kauffman 1921). Also reported from arctic Canada (Dearness 1923) and Québec (Pomerleau 1980). Our material corresponds well to Stuntz's (1947) description of *Inocybe lucifuga* (Fr.) Quél. from a subalpine *Abies-Pinus* forest in Washington, which is now considered a yellow variant of *I. floccosus* (Kuyper 1986). Not previously reported from western Canada.

Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10317); 09 07 97 (ALTA 10318); krummholz zone 09 11 94 (ALTA 10319).

Inocybe lacera (Fr.:Fr.) Kumm., Führ. Pilzk. p. 79. 1871.

A cosmopolitan generalist. Widespread in Europe and North America, not uncommon in subalpine and alpine areas, associated with *Betula, Castanea, Salix, Quercus, Alnus, Picea* and *Pinus* (Kuyper 1986, Arnolds *et al.* 1995). With *Salix* in the French and Swiss Alps (Kühner and Lamoure 1986, Favre 1955, Graf 1994), Scotland (Watling 1987), and the Faeröes (Möller 1945). In Greenland and Norway with *Betula* (Petersen 1977, Lange 1957, Gulden and Lange 1971) and with *Pseudotsuga menziesii* (Jansen 1991), *Picea abies* (Bieri 1995), or *Pinus sylvestris* (Scherfose 1990, Termorshuizen 1991, Väre *et al.* 1996) in northern Europe. Found throughout North America in various habitats but especially under *Populus* in northern U.S. and Canada (Kauffman 1924, Smith *et al.* 1979). Ectomycorrhizae of *I. lacera* have been described on *Populus tremuloides* (Cripps and Miller 1995). This taxon is extremely variable, especially arctic and alpine material. Forms such as *I. lacera* var. *heterosperma* Grund and Stuntz fit within the normal range of variation of *I. lacera* (Kuyper 1986). Not previously reported from western Canada.
Material examined: Mt. Tripoli: alpine zone 08 16 95 (ALTA 10320); krummholz zone 08 04 95 (ALTA 10321).

Inocybe lanuginella (Schroet.) J. E. Lange, Dansk Bot. Arkiv 2: 45. 1917.

An alpine *Dryas* associate. Reported from Switzerland with *Dryas* (Favre 1955)(as *Inocybe decipiens* and *I. decipientoides*), Norway at subalpine elevations (Gulden and Lange 1971), and Denmark (Lange 1917), Greenland and Lapland with *Salix* (Lange 1957). Horak (1987) maintains that *I. lanuginella* (as *Astrosporina lanuginella*) is specific to *Dryas* on calcareous soil, which brings the material collected with *Salix* into doubt. Synonymous with *Inocybe decipientoides* Peck and *I. globocystis* Vel. *fide* Horak (1987). Our material was collected with *Dryas octopetala*. Not previously reported from Canada.
Material examined: Mt. Rae: alpine zone 08 16 95 (ALTA 10322).

Inocybe rimosa (Bull.:Fr.) Kumm., Führ. Pilzk. p. 79. 1871.

A cosmopolitan generalist. Widespread in Europe and North America, associated with a wide range of coniferous and angiosperm hosts including alpine vegetation (Kuyper 1986). Common throughout the Alps (Favre 1955, Kühner and Lamoure 1986, Graf 1994, Senn-Irlet 1988), Scandinavia (Gulden and Lange 1971, Jacobsson 1984), Scotland (Watling 1987), Greenland (Lange 1957, Petersen 1977) and Svalbard (Ohenoja 1971) with *Salix* and *Dryas*. Also associated with *Pinus sylvestris* in Germany (Scherfose 1990), with conifers or *Quercus* in California (Nishida 1989) and throughout the U.S. and Canada in a wide variety of habitats (Kauffman 1924, Grund and Stuntz 1981). Synonymous with *I. fastigiata* (Schiff.: Fr.) Quél. *fide* Kuyper (1986).
Material examined: Mt. Tripoli: krummholz zone 08 04 95 (ALTA 10323). Mt. Rae: subalpine forest 09 07 97 (ALTA 10324).

Inocybe whitei (Berk. & Broome) Sacc., Syll. Fung. 5: 790. 1887.

A western conifer associate. Widespread in central Europe, usually with *Picea* or *Pinus* but also rarely with deciduous trees (Kuyper 1986, Arnolds *et al.* 1995). Known from California with conifers or *Quercus* (Nishida 1989) and from mixed forests in Nova Scotia (Gourley 1983) and British Columbia (Bandoni 1977) (both as *I. pudica*). Very common with conifers on the west coast of North America but rare east of the Rockies (Smith *et al.* 1979, Grund and Stuntz 1981). Synonymous with *I. pudica fide* Kuyper (1986). Not previously reported from Alberta.
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 10325); 09 07 97 (ALTA 10326).

Thaxterogaster pingue Sing. & A. H. Sm., Brittonia 10: 211. 1958.

A montane conifer associate; under *Abies lasiocarpa* as well as *Pinus* and *Pseudotsuga* spp. from the Pacific Northwest to Colorado and California (Singer and Smith 1958). Especially at higher elevations, under *Picea* in the Rockies, *Abies* in the Sierra Nevada and Cascade Mountains (Arora 1986) and under mixed conifers in British Columbia (P. Kroeger pers. comm. 1998). The genus *Thaxterogaster* has not been previously reported from Alberta.
Material examined: Mt. Rae: subalpine forest 09 19 97 (ALTA 10349).

Gomphidiaceae

Gomphidius largus O. K. Miller, Mycologia 63:1159. 1971.

A montane conifer associate. Under *Picea engelmannii* in Idaho, and *Populus* and *Picea* spp. in New Mexico, at high elevations (up to 3,000 m)(Miller 1971). Distinguished from *G. glutinosus* (Fr.) Fr. by the presence of inflated cellular gill trama. Gill trama cells in our material are up to 43 μm wide. Not previously reported from Canada.
Material examined: Mt. Rae: subalpine forest 08 17 97 (ALTA 10378).

Hydnaceae

Hydnum repandum Fr., Syst. Mycol. 1: 400. 1821.

Cosmopolitan, with a broad host range (Molina *et al.* 1992). In Europe with deciduous trees or *Pinus* or *Picea* up to subalpine elevations (Breitenbach and Kränzlin 1986, Scherfose 1990, Gulden *et al.*1992). Associated with *Picea abies, Pseudotsuga menziesii*, *Fagus* and *Corylus* (Trappe 1962). Widely distributed throughout the U.S. and Canada (Smith and Smith 1973); under *Picea engelmannii* and *Abies lasiocarpa* in Colorado (Kauffman 1921), *Quercus* and *Pinus* in southern Oregon (Kauffman 1929) and *Picea glauca* and *Populus* in central Alberta (Schalkwijk 1989, 1991, Currah *et al.* 1989).
Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10278).

Hysterangiaceae

Hysterangium separabile Zeller, Mycologia 33: 201. 1941.

Hypogeous under conifers, deciduous trees and shrubs. Common in the

mountains of western North America but widely distributed (Smith and Smith 1973). Known from Europe, South America, New England, New York, Arizona, California, Oregon and Wyoming (Zeller 1941). With conifers and *Quercus* in California (Arora 1986) and *Tsuga canadensis, T. heterophylla* and *T. mertensiana* in the Pacific Northwest (Kropp and Trappe 1982). Under *Pinus, Populus*, *Pseudotsuga*, *Alnus* and (or) *Picea* spp. in the Rocky Mountain foothills (Currah *et al.* 1989).
Material examined: Mt. Rae: subalpine forest 07 21 95 (ALTA 10198); 08 16 95 (ALTA 10379).

Russulaceae

Lactarius alnicola A. H. Sm., Brittonia 12: 319. 1960.

A western conifer associate. Known from Michigan, California, Oregon, Idaho and Wyoming (Hesler and Smith 1960). Common in the northern Rockies (Hesler and Smith 1979) and their foothills with mixed *Picea* and *Pinus contorta* (Currah *et al.* 1989). Originally collected under *Alnus,* but now recognized as a conifer associate (Hesler and Smith 1979). Ectomycorrhizae on *Picea engelmannii* are described by Kernaghan *et al.* (1997).
Material examined: Mt. Tripoli, subalpine forest 09 11 94 (ALTA 9870); 08 30 97 (ALTA 10248); 09 07 97 (ALTA 10249).

Lactarius caespitosus Hesler & A. H. Sm., N. Am. sp. *Lactarius*, p. 349. 1979

An *Abies* associate. Common in the spruce-fir zone of the Rocky mountains, rare west of the crest of the Cascade Mountains (Hesler and Smith 1979). Ectomycorrhizae described on *Abies lasiocarpa* by Kernaghan *et al.* (1997) are probably restricted to that host. Not previously reported from Canada.
Material examined: Mt. Rae: subalpine forest 09 24 94 (ALTA 9871); 08 16 95 (ALTA 10250); 09 29 95 (ALTA 10251); 09 19 97 (ALTA 10252); krummholz zone 08 16 95 (ALTA 10253). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10254); 08 15 95 (ALTA 10255); 09 07 97 (ALTA 10256); krummholz zone 08 04 95 (ALTA 10257).

Lactarius deliciosus var. *areolatus* A. H. Sm., Brittonia 12: 135. 1960.

A western conifer associate. In Europe, *L. deliciosus s.l.* (an unresolved complex) is normally found with *Pinus* (Hesler and Smith 1979, Arnolds *et al.* 1995). In North America, *L. deliciosus s.l.* has been reported from a wide range of habitats, including Nova Scotia with *Picea* and *Abies* (Smith and Wehmeyer 1936), boreal forest and tundra in northern Québec (Hutchison *et al.* 1988) and northern Alberta with *Pinus banksiana* (Visser 1995). Ectomycorrhizae have been synthesized on *Larix occidentalis, Picea sitchensis, Pseudotsuga menziesii, Tsuga heterophylla* and a number of *Pinus* spp. (Molina and Trappe 1982). *L. deliciosus* var. *areolatus* is the most common variant in the west and is abundant in the Rocky Mountains; reported from Alaska to New Mexico under mixed conifers (Hesler and Smith 1979). Ectomycorrhizae on *Abies lasiocarpa* have been described by Kernaghan *et al.* (1997). This variety has not been previously reported from western Canada.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10258); 09 19 97 (ALTA 10259); subalpine forest 08 16 95 (ALTA 10260); 09 19 97 (ALTA 10261).

Mt. Tripoli: krummholz zone 08 05 94 (ALTA 9872).

Lactarius luculentus Burl., Mycologia 28: 260. 1936. *sensu lato.*

A western conifer associate. Under *Pseudotsuga menziesii* in Oregon, Colorado and Alaska (Burlingham 1936, Hesler and Smith 1979). Kauffman's (1921) report of *L. subdulcis* under *Pinus* in Colorado may have been *L. luculentus*, because *L. subdulcis* is a similar European species not recognized from North America in the most recent monograph (Hesler and Smith 1979). Hesler and Smith (1979) describe *L. luculentus* var. *luculentus* and var. *latetus* Hesler and Smith from North America. These fungi are part of a complex of small, reddish orange *Lactarii* with white unchanging latex (or latex which becomes yellow on white paper), which also includes *L. mitissimus* (Fr.) Fr. and *L. aurantiacus* Fr. Our material has glabrous, papillate, dark apricot coloured pilei, slightly paler towards margin, up to 3 cm in diam. Pileus cuticle an ixotrichoderm, lacking incrusting material. Stipe concolorous, very finely fibrillose, stuffed becoming hollow, ± equal, up to 3.5 cm. Lamellae slightly paler, slightly decurrent. Context whitish, taste slightly acrid. Latex scant, white, unchanging. No parts reacting in 5% KOH. Spores (6.5) 7.0-8.5 (9.5) x 5.5-6.7 (7.3) μm, ornamentation a broken reticulum with isolated warts. Not previously reported from Canada.

Material examined: Mt. Rae: krummholz zone 09 19 97 (ALTA 9875); subalpine forest 09 19 97 (ALTA 10262). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10263).

Lactarius pubescens Fr., Epicr. Syst. Mycol., p. 335. 1838.

Associated with *Betula* and members of the Salicaceae. Reported from northern Europe with *Betula* (Kallio and Kankainen 1966, Jacobsson 1984, Arnolds *et al.* 1995), Greenland with *Betula* or *Salix* (Lange 1957, Knudsen and Borgen 1982), Alaska with *Betula nana* and *B. papyrifera* (Miller 1982) and *Salix alaxensis* (Laursen and Ammirati 1982) and central Alberta with *Betula papyrifera* (Schalkwijk 1989). Common throughout the boreal forest (Rendall 1980). Mycorrhizae have been synthesized *in vitro* with *Populus tremuloides* (Godbout and Fortin 1985). Hesler and Smith (1979) also recognize *L. pubescens* var. *betulae*, with yellowing latex and smaller spores than var. *pubescens*.

Material examined: Mt. Tripoli: krummholz zone 08 05 94 (ALTA 9874); 09 11 94 (ALTA 10264); 08 15 95 (ALTA 10265); 08 30 97 (ALTA 10266); 09 07 97 (ALTA 10267).

Russula brevipes Peck, 43rd Rep. N.Y. St. Mus. p. 20. 1890.

Common and widely distributed, mainly with conifers but also with angiosperms. Also in arctic and alpine habitats. Known from northeastern North America with *Abies, Picea, Pinus, Populus* and *Betula* (Shaffer 1964, Stanis 1979, Pomerleau 1980), Alaska (Kobayashi *et al.* 1967), the Pacific Northwest with *Pseudotsuga, Abies, Picea, Pinus, Tsuga* (Trappe 1962, Shaffer 1964), and Alberta with *Picea glauca* (Schalkwijk 1989, Currah *et al.* 1989). Ectomycorrhizae described on *Abies lasiocarpa* (Kernaghan *et al.* 1997). Shaffer (1964) describes *R. brevipes* var. *acrior* Shaffer, which has a blue-green tint to stipe apex and (or) lamellae and a similar distribution to var. *brevipes*. *Russula delica* Fr. is a similar species commonly

reported from Europe in temperate areas with *Pinus, Quercus*, *Fagus* and other deciduous trees, also with montane *Picea* and in alpine regions with *Dryas* (Romagnesi 1967, Einhellinger 1987, Arnolds *et al.* 1995). It is unclear if *R. delica* and *R. brevipes* are conspecific, but Shaffer (1964) suggests rejecting the name *R. delica* and using *R. brevipes* for North American material.
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 9878); 08 04 95 (ALTA 10235).

Russula integra (Vittad.) Fr., Epicr. Syst. Mycol., p. 360. 1838.

A montane conifer associate, restricted to Pinaceae (Molina *et al.* 1992). Common in central and northern Europe in montane and subalpine *Picea-Abies* forests, or with *Pinus sylvestris,* also at lower elevations in mixed forests (Romagnesi 1967, Einhellinger 1987, Hansen and Knudsen 1992). Reported with *Pseudotsuga* in California (Arora 1986) and *Abies* in Nova Scotia (Smith and Wehmeyer 1936). Mycorrhizae described on *Abies lasiocarpa* (Kernaghan and Currah unpublished data). Not previously reported from western Canada.
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 9880); 08 04 95 (ALTA 10236); 09 07 95 (ALTA 10237); subalpine forest 09 11 94 (ALTA 10238); 08 04 95 (ALTA 10239).

Russula silvicola Shaffer, Beih. Nova Hedwigia 51: 229. 1975.

Associated with coniferous and deciduous trees, often with *Abies*. Known from eastern North America in deciduous, coniferous or mixed forests (Shaffer 1975); from Ontario and Québec under *Abies, Picea* and mixed deciduous trees (Nantel and Neumann 1992, Stanis 1979). Ectomycorrhizae described on *Abies lasiocarpa* (Kernaghan *et al.* 1997). *R. emetica* (Schaeff.:Fr.) Pers. ex S.F. Gray var. *silvestris* Sing., which may be conspecific (see Shaffer 1975), is known from Europe with *Pinus sylvestris, Picea abies* and in mixed forests (Einhellinger 1987, Kühner and Romagnesi 1953) and Colorado (Kauffman, 1921). Not previously reported from western Canada.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10240); 09 19 97 (ALTA 10241); subalpine forest 09 14 96 (ALTA 10242); 09 19 97 (ALTA 10243). Mt. Tripoli: krummholz zone 08 05 94 (ALTA 9881); subalpine forest 09 11 94 (ALTA 10244); 09 07 97 (ALTA 10245).

Russula torulosa Bres., Iconogr. Mycol. 9: 433. 1929.

A conifer associate, usually with *Pinus*. Known from central and northern Europe with *Pinus*, more rarely under *Picea* (Romagnesi 1967, Hansen and Knudsen 1992, Arnolds *et al.* 1995). Also from Washington with *Tsuga mertensiana* and *Pseudotsuga menziesii* (Grund 1965). Moser and McKnight (1987) report the closely related *R. queletii* from tree line in Wyoming with *Picea engelmannii*. Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 09 24 94 (ALTA 9877); 09 29 95 (ALTA 10246); 09 07 97 (ALTA 10247).

Scutigeraceae

Albatrellus flettii Morse ex Pouz., Česka Mycol. 26: 198. 1972.

A western conifer associate. Known from Alaska, Alberta, British Columbia, California, Idaho, New Mexico, Oregon, Washington and Wyoming, typically with *Tsuga,* but *Abies*, *Picea, Pinus, Pseudotsuga, Taxus, Alnus* and *Salix* also reported in the vicinity (Gilbertson and Ryvarden 1986, Ginns 1997). Restricted to the Pinaceae (Molina *et al.* 1992) and associated with *Tsuga heterophylla* (Kropp and Trappe 1982).

Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10380).

Thelephoraceae

Boletopsis subsquamosa (Fr.) Kotlaba & Pouz., Česka Mycol. 11: 164. 1957.

A circumboreal conifer associate. Known from northern U.S. and Canada, uncommon (Gilbertson and Ryvarden 1986). Reported from Nova Scotia with *Picea* and *Pinus* (Gourley 1983). Ectomycorrhizae described on *Picea abies* by Agerer (1992), [as *B. leucomelaena* (Pers.: Fr.) Fayod].

Material examined*:* Mt. Rae: krummholz zone 08 12 94 (ALTA 10354); subalpine forest 09 24 94 (ALTA 10355); 08 16 95 (ALTA 10356); 09 14 96 (ALTA 10357); 09 19 97 (ALTA 10358).

Hydnellum caeruleum (Hornem.) P. Karst., Medd. Soc. Fauna Fl. Fenn. 5: 41. 1879.

Associated with conifers in the north and broadleaved trees in the south. Known from Europe with *Pinus sylvestris* (Scherfose 1990, Väre *et al.* 1996, Arnolds *et al.* 1995) or in mixed forests (Breitenbach and Kränzlin 1986). In California with *Quercus*, *Lithocarpus* and *Arbutus* (Arora 1986) and in Florida (Baird and Kahn 1986). Also common in northern conifer forests (Nova Scotia, Québec), especially with *Pinus* (Harrison 1961, 1968, Pomerleau 1980), and in Alberta with *Picea glauca* and *P. engelmannii* (Currah *et al.* 1989, Schalkwijk 1991). Mycorrhizae described on *Picea engelmannii* (Kernaghan and Currah unpublished data).

Material examined: Mt. Rae: subalpine forest 08 12 94 (ALTA 10272); 09 24 94 (ALTA 10273); 08 16 97 (ALTA 10274); 09 19 97 (ALTA 10275).

Hydnellum suaveolens (Scop.:Fr.) P. Karst., Medd. Soc. Fauna Fl. Fenn. 5: 41. 1879.

A northern and montane conifer associate. Known from Europe with montane *Picea* (Breitenbach and Kränzlin 1986) and in North America from New Mexico to British Columbia and from the Appalachian Mountains to Nova Scotia (Harrison 1968, Kauffman 1921). With *Picea abies* in North Carolina (Baird 1986) and with *Picea engelmannii* and *Abies lasiocarpa* in Alberta (Schalkwijk 1991).

Material examined: Mt. Tripoli: krummholz zone 08 05 94 (ALTA 10277).

Pseudotomentella tristris (P. Karst.) M. J. Larsen, Nova Hedwigia 22: 613. 1971.

Widely distributed throughout the northern Hemisphere (Kõljalg 1996). In North America, from British Columbia to New Mexico and New Jersey (Larsen

1971). Commonly fruiting on a wide variety of decaying coniferous and deciduous wood (Larsen 1971, Ginns and Lefebvre 1993, Kõljalg 1996).
Material examined: Mt. Tripoli: subalpine forest ALTA 09 06 97 (ALTA 10276).

Sarcodon scabrosus (Fr.) P. Karst., Rev. Mycol. 3: 20. 1881.

Widespread, associated with conifers in the north and broadleaved trees in the south. In Switzerland and the Netherlands with *Fagus, Quercus* and *Castanea* and in Scandinavia with *Pinus* (Breitenbach and Kränzlin 1986, Arnolds *et al.* 1995). With *Liriodendron* and *Quercus* in southeastern North America (Baird 1986, Baird and Khan 1986), conifers or hardwoods in California (Arora 1986), conifers in Nova Scotia (Harrison 1961), *Tsuga heterophylla* in the Pacific Northwest (Hall and Stuntz 1972) and *Picea glauca* in the Rocky Mountain foothills (Currah *et al.* 1989).
Material examined: Mt. Rae: subalpine forest 09 19 97 (ALTA 10268).

***Sarcodon* sp.**

Sporocarps gregarious, solitary or fused, pileus 2-15 cm in diam., pale argillaceous when young, then pale tan to greenish yellow, older parts olivaceous, bruising purple, concave, undulating to nearly plane, with persistently incurved margin, matted fibrillose at first, soon forming coarse scales with dark vinaceous brown edges, slightly olivaceous in 5% KOH. Teeth 3-17 mm in length, crowded, gray with paler tips, bruising lavender from the tip, decurrent to halfway down the stipe, strongly olivaceous in 5% KOH. Stipe 5-9 x 1.5-4.5 cm, central or eccentric, often fused, ± equal with pointed base, pale orange, lower portion olivaceous, bruising purple, olivaceous in KOH. Context, white, fibrous, no reaction in KOH. Spores small, tuberculate, 3.7-5.0 x 2.8-3.6 μm. These collections appear similar to *S. versipellis* (Fr.) Quél. but differ in colour, length of teeth and bruising reaction.
Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10269); 08 18 95 (ALTA 10270). Mt. Tripoli: krummholz zone 09 06 97 (ALTA 10395); subalpine forest 09 11 94 (ALTA 10271).

Thelephora caryophyllea Fr., Syst. Mycol. 1: 430. 1821.

A north temperate species, on sandy soil under conifers (Corner 1968). Known from Finnish Lapland with *Pinus* and *Betula* (Kallio and Kankainen 1964), the Netherlands with *Pinus* or *Picea* (Arnolds *et al.* 1995), Germany with *Pinus sylvestris* (Scherfose 1990) and the Swiss Alps with dwarf alpine *Salix* spp. (Senn-Irlet 1988). In Colorado with montane conifers (Kauffman 1921), central Alberta under *Populus tremuloides* (Schalkwijk 1989) and northern Alberta with *Pinus banksiana* (Visser 1995).
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10392).

Tomentella ellisii (Sacc.) Jülich & Stalpers, Verh. K. Ned. Akad. Wet. 74: 236. 1980.

Distributed throughout the temperate northern hemisphere (Jülich and Stalpers 1980). Commonly fruiting on a wide variety of decaying coniferous and deciduous wood (Kõljalg 1996, Ginns and Lefebvre 1993). Not previously reported from Alberta. Some of our collections were from alpine soil supporting *Dryas octopetala*.
Material examined: Mt. Rae: alpine zone 08 16 97 (ALTA 10393); 09 19 97 (ALTA

10396). Mt. Tripoli: subalpine forest 09 07 97 (ALTA 10395).

Tomentella sublilacina (Ellis & Holw.) Wakef., Mycologia 52: 931. 1960.

Distributed throughout the temperate northern hemisphere (Larsen 1974, Jülich and Stalpers 1980). Commonly fruiting on a wide variety of decaying coniferous and deciduous woods (Larsen 1974, Ginns and Lefebvre 1993, Kõljalg 1996). Mycorrhizal with *Pinus muricata* in California (Gardes and Bruns 1996). Reported from Kootenay National Park, British Columbia, on deciduous wood and from Banff National Park, Alberta, on coniferous wood (Larsen 1975, as *T. kootenaiensis* Larsen). Our collections were from alpine soil with *Dryas octopetala*.
Material examined: Mt. Rae: alpine zone 08 16 97 (ALTA 10394); 09 19 97 (ALTA 10397).

Tricholomataceae

Camarophyllus pratensis (Fr.) Kumm., Führ. Pilzk., p. 117. 1871.

Cosmopolitan, often in open grassy areas or forest edges (Breitenbach and Kränzlin 1991) but also in thickets or dense forests (Hesler and Smith 1963, Smith *et al.* 1979, Bird and Grund 1979). Reported with subalpine *Betula* in Sweden (Jacobsson 1984).
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10342); 08 30 97 (ALTA 10381); 09 07 97 (ALTA 10382). Mt. Rae: subalpine forest 08 16 95 (ALTA 10344); 09 19 97 (ALTA 10383).

Catathelasma imperiale (Fr.) Sing., Rev. Mycol. 5: 9. 1940.

A circumboreal conifer associate. Known from Europe, Asia and the west and east coasts of North America, mainly with *Picea,* but also *Pseudotsuga, Tsuga, Abies* and rarely *Pinus* (Hutchison 1992). Restricted to Pinaceae (Molina *et al.* 1992).
Material examined: Mt. Rae: subalpine forest 09 24 94 (ALTA 10367); 09 29 95 (ALTA 10368); 09 14 96 (ALTA 10369); 09 19 97 (ALTA 10370). Mt. Tripoli: krummholz zone 09 08 96 (ALTA 10371); subalpine forest 09 07 97 (ALTA 10372). Rocky-Clearwater Forest AB: R. Currah, 08 06 86 (UAMH 5451).

Hygrophorus chrysodon (Fr.) Fr., Epicr. Syst. Mycol., p. 320. 1838.

Widely distributed in North America, associated with conifers and angiosperms. Common in western North America but apparently rare in the east (Hesler and Smith 1963); with *Lithocarpus* and *Arbutus* in coastal California (Arora 1986), *Pseudotsuga menziesii* in the Pacific Northwest (Trappe 1962), montane conifers in Colorado (Kauffman 1921), *Betula nana* and *Dryas octopetala* in Alaska (Miller 1982) and *Picea* or *Pinus* spp. in Alberta (Currah *et al.* 1989, Danielson 1984, Visser 1995).
Material examined: Mt. Rae: krummholz zone 09 24 94 (ALTA 10327); 09 29 95 (ALTA 10328); 09 19 97 (ALTA 10329); subalpine forest 09 19 97 (ALTA 10329). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10330); 08 15 95 (ALTA 10331); 09 07 97 (ALTA 10332).

Hygrophorus erubescens (Fr.) Fr., Epicr. Syst. Mycol., p. 322. 1838.

Circumpolar, usually with *Picea*. Restricted to Pinaceae (Molina *et al.* 1992). In Fennoscandia and Switzerland with *Picea*, especially at montane to subalpine elevations (Breitenbach and Kränzlin 1991, Gulden *et al.*1992, Hansen and Knudsen 1992, Bieri 1995). In northern U.S. and Canada with *Pinus*, *Picea* and *Tsuga* (Hesler and Smith 1963, Smith *et al.* 1979, Bird and Grund 1979); in Alberta under *Picea glauca*, *Pinus contorta* (Currah *et al.* 1989, Schalkwijk 1991) and *Pinus banksiana* (Visser 1995).

Material examined: Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10333); 08 15 95 (ALTA 10334); 09 07 97 (ALTA 10335). Mt. Rae: subalpine forest 09 19 97 (ALTA 10336).

Hygrophorus korhonenii Harmaja, Karstenia 25: 42. 1985.

A circumboreal *Picea* associate. Known from Fennoscandia and Québec, always with *Picea*. (Harmaja 1985, Hansen and Knudsen 1992). Harmaja (1985) states that *H. olivaceoalbus* (Fr.) Fr. *sensu* Hesler & A. H. Sm. does not fit the European concept of *H. olivaceoalbus*, but does fit the description of *H. korhonenii*. *H. olivaceoalbus sensu* Hesler & A. H. Sm. and is widely distributed in northern and western North America as well as France and the former U.S.S.R. with *Picea* (Hesler and Smith 1963). Distinctive features of *H. korhonenii* include a gelatinous outer veil covering a dark, fibrillose, inner veil, dark fibrillose veil remnants on the sitpe, spores measuring 10-14 x 5.2-7.5 μ m and a northern distribution. Not previously reported from western Canada, but has probably been collected and referred to as *H. olivaceoalbus sensu* Hesler and A. H. Sm., e.g. Schalkwijk (1991).

Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10337); 09 19 97 (ALTA 10338); krummholz zone 09 29 95 (ALTA 10339); 09 19 97 (ALTA 10340). Mt. Tripoli: subalpine forest 08 30 97 (ALTA 10341).

Hygrophorus pudorinus (Fr.) Fr., Epicr. Syst. Mycol., p. 322. 1838.

A circumboreal conifer associate. Often with *Abies* in Europe (Kühner and Romagnesi 1953, Breitenbach and Kränzlin 1991, Arnolds *et al.* 1995), but with *Picea* in Sweden (Hansen and Knudsen 1992) and the former U.S.S.R. (Hesler and Smith 1963). Under *Picea*, *Abies* or *Tsuga* in northern and western U.S. and Canada (Smith *et al.* 1979, Bird and Grund 1979, Arora 1986). With *Picea engelmannii*, *Abies lasiocarpa* and *Pinus contorta* in Colorado (Kauffman, 1921), in boreal forest in northern Québec (Hutchison *et al.* 1988) and *Picea* and *Pinus* in the Canadian Rockies (Schalkwijk 1989).

Material examined: Mt Tripoli: subalpine forest 09 11 94 (ALTA 10343). Mt. Rae: subalpine forest 09 19 97 (ALTA 10345).

Hygrophorus pustulatus (Fr.) Fr., Hymen. Eur., p. 411. 1874.

A widespread conifer associate. Throughout European *Picea* forests, up to subalpine elevations (Breitenbach and Kränzlin 1991, Arnolds *et al.* 1995). Under *Abies* and *Sequoia* in Michigan, Colorado, Wyoming, Idaho, California and Washington (Hesler and Smith 1963) and with *Picea* in Nova Scotia (Bird and Grund 1979). Not previously reported from western Canada.

Material examined: Mt Rae: subalpine forest 09 19 97 (ALTA 10346)

Hygrophorus speciosus Peck, N.Y. State Mus. Ann. Rept. 29: 43. 1878.

A circumboreal *Larix* associate (Hesler and Smith 1963). Known from montane to subalpine Switzerland (Breitenbach and Kränzlin 1991), up to tree line the Austrian Alps with *Larix decidua* (Moser 1982) and with *Larix laricina* in Nova Scotia (Bird and Grund 1979) and Québec (Hutchison *et al.* 1988, Pomerleau 1980). Reported from the southwest U.S. with *Pinus ponderosa* (Arora 1986). Not previously reported from western Canada or in association with *Larix lyallii*.
Material examined: Mt. Rae: krummholz zone 07 25 95 (ALTA 10347); subalpine forest 09 19 97 (ALTA 10348).

Laccaria montana Sing., Sydowia 7: 89. 1973.

Circumpolar and alpine, with conifers and angiosperms. Restricted to arctic, boreal or montane habitats; Switzerland, the Faeröes, Colorado, Idaho, Montana, Washington, Wyoming, Alaska, and British Columbia with members of the Pinaceae, *Betula* and *Salix* (Mueller 1992). Also reported from Iceland and Norway (including Svalbard) (Hansen and Knudsen 1992) with *Salix* (Gulden 1988). Not previously reported from Alberta.
Material examined: Mt. Tripoli: krummholz zone 08 04 95 (ALTA 10384); 08 15 95 (ALTA 10385); 09 07 97 (ALTA 10386); subalpine forest 07 18 94 (ALTA 10387). Mt. Rae: alpine zone 08 16 95 (ALTA 10388); subalpine forest 08 16 95 (ALTA 10389).

Tricholoma myomyces (Fr.) Lange, Dansk. Bot. Ark. 8: 21. 1933.

A widespread conifer associate. In northern Europe, often with *Pinus* (Hansen and Knudsen 1992, Arnolds *et al.* 1995) or on sand dunes with *Pinus* and *Salix* (Moser 1983). Under planted *Picea* and *Pinus* in the Great Lakes region with variations found throughout northern U.S. and Canada (Smith *et al.* 1979); in Sweden, Michigan, Minnesota, Pennsylvania, Wisconsin, and Ontario under most species of *Pinus* and *Picea* as well as *Tsuga canadensis* (Ovrebo 1980, 1989). In Alberta with *Picea* and *Pinus* (Currah *et al.* 1989).
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10288); 08 04 95 (ALTA 10289); 09 07 97 (ALTA 10290). Mt. Rae: subalpine forest 07 25 95 (ALTA 10291); 09 19 97 (ALTA 10292).

Tricholoma saponaceum (Fr.) Staude, Schwämme Mitteldtsch., p. 127. 1858.

Widespread, associated with conifers and angiosperms. Known from northern Europe with *Picea* (Gulden *et al.*1992), *Pinus sylvestris* (Väre *et al.* 1996), *Fagus* or *Quercus* (Arnolds *et al.* 1995). In northeastern North America with *Abies, Picea, Tsuga* or *Pinus* spp. (Ovrebo 1980), northern Alberta with *Pinus banksiana* (Visser 1995), Nova Scotia with *Picea* (Smith and Wehmeyer 1936), Colorado with *Picea engelmannii* and *Pinus contorta* (Kauffman 1921), central Alberta with *Populus tremuloides* (Schalkwijk 1989) or *Pinus contorta* (Currah *et al.* 1989), and California with *Lithocarpus* and *Arbutus* (Arora 1986).
Material examined: Mt.Tripoli: subalpine forest 09 11 94 (ALTA 10293); 09 07 97 (ALTA 10294). Mt. Rae: krummholz zone 09 24 94 (ALTA 10295); subalpine forest 07 21 94 (ALTA 10296); 07 25 95 (ALTA 10297); 08 16 95 (ALTA 10298); 08 16 97 (ALTA 10299).

Tricholoma vaccinum (Pers.: Fr.) Staude, Schwämme Mitteldtsch., p. 128. 1858.

A circumboreal *Picea* associate, also reported with *Pinus*. In central and northern Europe with *Picea* up to subalpine elevations (Breitenbach and Kränzlin 1991, Hansen and Knudsen 1992, Bieri 1995). Widely distributed in northern U.S. and Canada with *Picea* and (or) *Pinus* (Smith *et al.* 1979, Ovrebo 1980); with *Pinus* in northern California (Arora 1986), *Picea glauca* in N.W.T (Bigelow 1959) and *Picea glauca, Picea engelmannii* and *Pinus contorta* in the Canadian Rockies (Currah *et al.* 1989, Schalkwijk 1991). Ectomycorrhizae are described on *Picea abies* by Agerer (1987b).

Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10300); 09 19 97 (ALTA 10301); 09 19 97 (ALTA 10302). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10303); 09 07 97 (ALTA 10304).

Tricholoma virgatum (Fr.) Kumm., Führ. Pilzk., p. 134. 1871. var. *vinaceum* Ovrebo and Tylutki, Mycologia 67: 79. 1975.

Probably a montane conifer associate. *T. virgatum* var. *virgatum* is common in Europe with conifers and *Fagus* (Bon 1984) and throughout the northern forests of North America with *Pinus* and *Picea* (Ovrebo 1989). *T. virgatum* var. *vinaceum*, also a conifer associate, has a vinaceous flush to the stipe with age or upon bruising, and is known from Idaho, Oregon and Washington (Ovrebo 1975). Bon (1984) describes *T. virgatum fo. rosipes* Bon in Europe, also with a reddening stipe and growing with montane conifers. Given this, and the locations of the North American collections, it is likely that *T. virgatum* var. *vinaceum* is a montane or northern variety. In our collections all but lamella tissue became vinaceous upon handling. *T. virgatum* var. *vinaceum* has not been previously reported from Canada.

Material examined: var. *vinaceum* - Mt. Rae: subalpine forest 09 24 94 (ALTA 10305); 09 29 95 (ALTA 10306); 09 19 97 (ALTA 10307); krummholz zone 09 24 94 (ALTA 10308). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10309); 09 07 97 (ALTA 10310). Priest Lake Idaho: C. Ovrebo, 11 05 72 (CO 90). Var. *virgatum* - Idaho: E. Tylutki (EET 6600). Muskoka Dist., Ontario: L. Hutchison 19 09 86 (LH-96-86); 09 17 94 (LH-93-94). Devon, Alberta: S. Abbott (M0272, M05576, M0366).

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GYMNOPILUS PURPUREOSQUAMULOSUS AND G. OCHRACEUS SPP. NOV. (AGARICALES, BASIDIOMYCOTA) — TWO NEW SPECIES FROM ZIMBABWE

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SUMMARY

Gymnopilus purpureosquamulosus and *G. ochraceus* are proposed as new species. They were both found on decaying wood in mist riparian woodland at Victoria Falls in Zimbabwe.

Whilst undertaking field work at Victoria Falls, Zimbabwe, in January 1992 two species of *Gymnopilus* P. Karst. were collected on decaying wood on the riparian forest floor. Although various *Gymnopilus* species are frequently encountered on dead wood in tropical and subtropical Africa, little has been published on the genus from this region. For instance, Pegler (1977) mentions only three species from East Africa, none of them similar to those found at Victoria Falls. In February 1995 I visited the fungus collections in the Royal Botanic Gardens, Kew, but was unable to find any collection of *Gymnopilus* matching my specimens, neither from Africa nor from any other part of the world.

AREA

Victoria Falls is situated in the river Zambezi on the border between Zambia and Zimbabwe. The fungi were collected in Zimbabwe, in the province North Matabeleland, between Devil's Cataract and the Main Falls, at 880 m altitude. Average highest temperature (October) is 25 °C and average lowest temperature (July) is 15 °C, annual rainfall is 715 mm (Sayce 1987). Victoria Falls has been identified as the latest of a series of faults that have criss-crossed the bedrock plain of River Zambezi since the breakup of Gondwanaland (Sayce 1987, Nugent 1990). The flow of water over the falls varies from 20 000 to 500 000 m^3 per minute (Sayce 1987). Due to the spray from the waterfall the vegetation near Victoria Falls has the appearance of a rain forest, but is actually only a dense and extensive riparian woodland (Timberlake et al. 1993) including many trees common for such habitats in Zimbabwe (Sayce 1987). However, it stands out more or less as an island of rain forest like vegetation

surrounded by dry mopane woodland (Wild & Grandvaux Barbosa 1967), and it contains some rare and even endemic species of higher plants (Sayce 1987).

METHODS

Preparations for the microscope were mounted in 5 % KOH. For each specimen ten mature, normally developed spores were measured by aid of an eyepiece micrometer and an oil-immersion objective (Zeiss, Ph 3, 100/1.25). I have used differences in length of 0.5 µm and have always omitted the apiculus. The spore measurements are given in the expression *(min)-avg*±σ*(n-1)-(max)*, where *avg* is the mean of 10 spores, σ*(n-1)* is the standard deviation, and *min* and *max* are the minimum and maximum values, respectively. The drawings of the spores were made by the aid of a camera-lucida with a Zeiss PlApo Oel 100/1.32 oil-immersion objective.

All specimens were tested chemically for soluble pigments by means of thin layer chromatography. Powdered, small fragments of lamella and pileus trama were extracted with 96 % ethanol for 15 minutes at 20 °C. The extracts were spotted on precoated Merck 60 silica gel aluminium plates and developed with a wash-liquid composed of ethylformiate : formic acid : toluene (50:15:35) saturated with water (Høiland 1984). The styrylpyrones hispidin and bis-noryangonin were identified by comparing the chromatograms with those published by Høiland (1990).

DESCRIPTIONS

Gymnopilus purpureosquamulosus Høil. sp. nov. (Figs 1A and 2A)

Pileus 5-7 cm latus, convexus vel umbilicatus, squamulosus, albo-luteus vel bubalinus, squamis adpressis, purpureis. *Lamellae* decurrentes, subflavo-aurantiacae. *Stipes* 4-7 × 0.6-1 cm, infirme clavatus, fibrillosus, pallide rubellus, annulo membranaceo. *Caro* albo-lutea vel pallide bubalina, leniter amara. *Sporae* (7.5)-8.25±0.40-(9) × (5)-5.2±0.24-(5.5) µm, ovoideae vel ellipsoideae, verrucosae. *Fructificationes* solitariae vel paucae ligno carioso insidens.

Holotype: L. Ryvarden and K. Høiland GZ 4, Zimbabwe, North Matabeleland, Victoria Falls, 29 Jan. 1992 (O).

Pileus 5-7 cm broad, convex to concave with a central depression, scaly with appressed squamules, specially on centre, ground colour whitish yellow to pale buff, the squamules reddish violet (somewhat like *Cortinarius bolaris*, but more violet). *Lamellae* adnate-decurrent to decurrent, yellow brown, then orange red brown. *Stipe* 4-7 × 0.6-1 cm, somewhat clavate, fibrillose, pale red, more red towards the base, with a narrow, membraneous, pale buff ring. *Context* whitish yellow to pale buff, with an astringent, weakly bitter taste.

Basidiospores (7.5)-8.25±0.40-(9) × (5)-5.2±0.24-(5.5) µm, ellipsoid to ovoid, coarsely verrucose to punctate, dextrinoid, yellow brown. *Basidia* 18-27 × 7-8 µm, four sterigmata. *Cheilocystidia* 16-20 × 5-9 (broadest part) µm, ventricose-rostrate with a clavate, rounded or globose apex, 4-5.5 µm broad, hyaline. *Pleurocystidia* not seen.

Hyphae of epicutis 3-17 µm broad, hyaline and smooth to weakly red brown with zebra-striped incrustation. *Hyphae of squamules* 3-13 µm broad, red brown with zebra-striped incrustation, in dense fascicles. *Clamp connections* present.

Chemistry: Hispidin and traces of bis-noryangonin.

Ecology: Very scattered on decaying hard-wood on the ground in lush, mist riparian forest. Only few (1-5) basidiocarps on each occurrence.

Comments: This new species is reminiscent of *G. peliolepis* (Speg.) Sing. from which it differs by its broader spores and more capitate cheilocystdia. This species is hitherto only recorded in tropical and subtropical America (Hesler 1969). *Gymnopilus dilepis* (Berk. & Br.) Sing., with decurrent lamellae and reddish violet squamules on the pileus (Petch 1907, Pegler 1986, Treu 1998), may also be similar. However, it deviates by that the squamules are erect over the centre, the veil is corticoid, not membraneous, and the spores are shorter (5.5-8.5 × 4.5-5.7 µm) (Pegler 1986, Treu 1998). It has a palaetropical distribution. Material in the Royal Botanic Gardens, Kew, shows that it occurs in tropical Africa from Nigeria to Kenya and tropical Asia from Sri Lanka over South East Asia, Borneo to Fiji. It is frequent on palm stumps (Pegler 1986, Treu 1998).

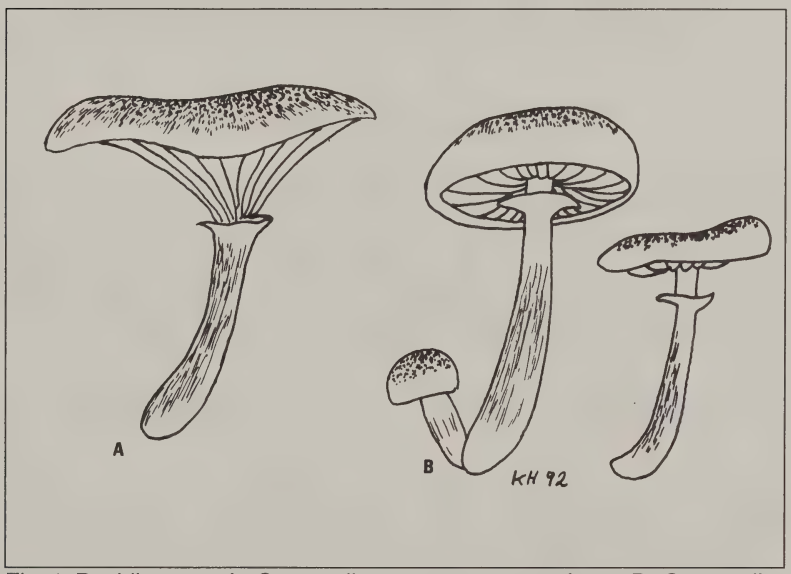


Fig. 1. Basidiocarps: A, *Gymnopilus purpureosquamulosus*; B, *Gymnopilus ochraceus*.

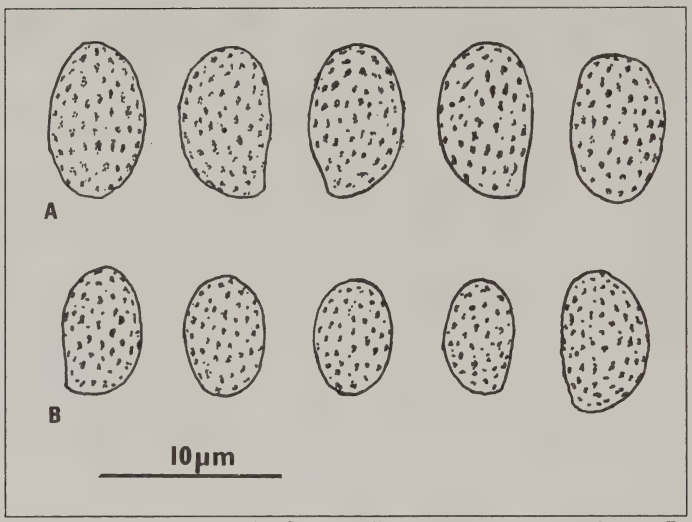


Fig. 2. Basidiospores: A, *Gymnopilus purpureosquamulosus*; B, *Gymnopilus ochraceus*, from the holotypes.

Gymnopilus ochraceus Høil. sp. nov. (Figs 1B and 2B)

Pileus 2-5 cm latus, convexus vel planus, raro umbilicatus, tomentosus vel squamulosus, pallide brunneus, melleus vel ochraceus, squamis adpressis, concoloris velut pileus. *Lamellae* subliberae vel basi adnatae rotundatae, subflavo-aurantiacae vel ferruginae. *Stipes* 2-8 × 0.5-1 cm, cylindricus vel infirme clavatus, fibrillosus, concolorus velut pileus, annulo membranaceo. *Caro* albo-lutea vel pallide bubalina, leniter amara. *Sporae* (6)-6.25±0.55-(7.5) × (4)-4.5±0.22-(5) µm, ovoideae vel ellipsoideae, verrucosae. *Fructificationes* copiosae ligno carioso insidens.

Holotype: L. Ryvarden and K. Høiland GZ 3, Zimbabwe, North Matabeleland, Victoria Falls, 29 Jan. 1992 (O).

Pileus 2-5 cm broad, convex to plane, seldom concave, felty to finely scaly with appressed squamules, specially at centre, ground colour pale brown, honey brown, pale ochraceus to pale yellow brown, the squamules yellow brown to honey brown. *Lamellae* adnexed to adnate, dark yellow brown to red brown. *Stipe* 2-8 × 0.5-1 cm, cylindrical to somewhat clavate, fibrillose, concolourous with pileus, with an ample, membraneous, pale buff to pale yellow brown ring. *Context* whitish yellow to pale buff, with a weakly bitter taste.

Basidiospores (6)-6.25±0.55-(7.5) × (4)-4.5±0.22-(5) µm, ellipsoid to ovoid, coarsely verrucose to punctate, dextrinoid, yellow brown. *Basidia* 16-25 × 5-6.5 µm, four sterigmata. *Cheilocystidia* 15-18 × 4.5-7 (broadest part) µm, ventricose-rostrate with a clavate or rounded apex, 3-3.5 µm broad, hyaline or with yellow to bright yellow brown content. *Pleurocystidia* not seen. *Hyphae of epicutis* 4.5-15 µm broad,

hyaline to pale yellow brown and smooth. *Hyphae of squamules* 3-7 µm broad, yellow brown with no or weak incrustation. *Clamp connections* present.

Chemistry: Hispidin and bis-noryangonin in nearly equal amounts.

Ecology: Gregarious on decaying hard-wood on the ground in lush, mist riparian forest.

Comments: The basidiocarps of this new species have an appearance of *Armillaria mellae* coll. in colour, shape and manner of growth. *Gymnopilus aureobrunneus* (Berk. & Curt.) Murr. is somewhat similar. However, it deviates by a more golden yellow pileus and cortinoid veil leaving a fibrillose zone towards the stipe apex, but never forming a membraneous ring (Hesler 1969, Pegler 1977, Ryvarden et al. 1994). It has a pantropical distribution (Hesler 1969, Pegler 1977). Material in the Royal Botanic Gardens, Kew, shows that it occurs in tropical Africa as well as America.

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A NEW SPECIES OF GLOIOCEPHALA FROM INDIA

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Abstract: *Gloiocephala resinopunctata sp. nov.* is described, illustrated and discussed based on collections made in Kerala State, India.

Gloiocephala Massee (Tricholomataceae, Agaricales, Basidiomycota) is a reduced marasmioid genus which Singer (1960, 1976, 1986) and several other authors accept as distinct from *Marasmius* Fries. Noordeloos (1981, 1987), however, considers it as a section of *Marasmius*. Although known mostly from the neotropics, species of *Gloiocephala* are also recorded from the temperate Northern Hemisphere, temperate South America, Indo-Malaya, Australasia and the Hawaiian Islands. Singer (1986) listed 25 species as well known within this genus. Several species, however, were described later (e.g., Horak & Desjardin, 1994; Desjardin, Martinez-Peck & Rajchenberg, 1995; Desjardin & Horak, 1997).

While studying the agaric flora of Kerala State, India, a new species of *Gloiocephala* was discovered which is described below. Colour notations used in the description are from Kornerup and Wanscher (1978). All specimens are deposited at SFSU.

Gloiocephala resinopunctata Manimohan & K.A. Thomas **sp. nov.**

Etymology: *L. resinopunctata*, resin-dotted.

Basidiocarpus parvulus, delicatus, pleurotoidus, revivascentus, primo albus, postea rubrobrunneus. Pileus 1-9 mm latus, cupulato-reniformis, subspathuloidus vel subflabelliformis, membranaceous, resino-punctatus. Lamellae adnatae, intervenosae. Acies lamellarum resino-punctata. Stipes brevissimus, lateralis vel excentricus, resino-punctatus. Odor nullus. Sporae in cumulo albae, 11-13 x 7.5-9 µm, late ellipsoideae vel subamygdaliformiae, laevis, hyalinae, inamyloideae. Basidia 34-60 x 8-14 µm, elongato-clavata, tetrasporigera. Cheilogloeocystidia 22.5-68 x 5-14 µm, versiformia, resinaceo rubrobrunneo instructa, tenuitunicata. Pleurogloeocystidia nulla. Trama hymenophoralis subregularis, subgelatinosa, inamyloidea, fibulata. Trama pilei subgelatinosa, inamyloidea, fibulata. Pileipellis et stipitipellis hymeniformis, ex cellulis globosis vel subglobosis et gloeocystidiis composita. Pileogloeocystidia et

caulogloeocystidia numerosa, cheilogloeocystidiis similia. Ad folia putrida palmarum. Holotypus: P. Manimohan M703e (SFSU).

Basidiomes very small, delicate, pleurotoid, frequently nutant, with the hymenial surface directed downwards, revivascent, initially pure white, with fine dots of a reddish brown (8D8, 8E8) resinous material on the surface of both pileus and stipe and on the lamella-edge, which either become coalesced to impart a reddish brown colour to the whole basidiome or get washed out by rain leaving dirty white or cream basidiomes, on drying acquire a brownish orange (6C8, 6D8) to rust brown (6E8) colour and a varnished appearance. Pileus 1-9 mm diam., cupulate-reniform, subspathuloid, subflabelliform or rarely convex-orbicular, membraneous; surface translucent and pellucid-striate when moist, slightly sticky, alveolate, glabrous; margin initially slightly incurved, becoming straight, entire. Lamellae narrowly adnate, only 2-4 fully developed lamellae per basidiome with shallow interveining in between, somewhat thick, up to 3 mm wide; edge resin-dotted. Stipe mostly very reduced with dimensions less than 0.5 x 0.5 mm, occasionally up to 5 mm x 1.5 mm, lateral or eccentric, terete, slightly broader towards the base, solid; surface smooth, glabrous, resin-dotted; base somewhat discoid in the beginning, not so when fully developed; not insititious; basal mycelium scanty. Spore print white.

Spores 11-13 x 7.5-9 µm, broadly ellipsoid to subamygdaliform, with a somewhat curved suprahilar region, thin-walled, hyaline, smooth, inamyloid (spores trapped in the resin acquire a reddish brown tint). Basidia 34-60 x 8-14 µm, elongate-clavate, thin-walled, hyaline, with abundant guttulate contents, 4-spored; sterigmata up to 7.5 µm long. Basidioles abundant, fusoid, with guttulate contents. Lamella-edge sterile with crowded cheilogloeocystidia; cheilogloeocystidia 22.5-68 x 5-14 µm, cylindric, cylindrico-clavate, clavate, sphaeropedunculate or subventricose, occasionally subcapitate thin-walled, frequently containing and exuding a yellowish to somewhat reddish brown resinous substance. Pleurogloeocystidia absent. Hymenophoral trama subregular, slightly gelatinized; hyphae 1.5-15 µm wide, thin-walled, hyaline, inamyloid, with clamp-connexions. Pileal trama slightly gelatinized; hyphae 1-19 µm wide, thin-walled, hyaline, inamyloid, with plenty of clamp-connexions. Pileipellis a hymenioderm of pileogloeocystidia similar in size, shape and nature to those seen on lamella-edge intermixed with globose, subglobose or pear shaped cells 12.5-27.5 x 8-17.5 µm, often mucronate and with a pedicel, thin-walled, hyaline; pileogloeocystidia outnumber the latter type of cells and frequently almost fully replacing them in some areas of the pileus. Stipe tissue inamyloid; hyphae 2-15 µm wide, thin-walled, hyaline. Stipitipellis similar to pileipellis in all respects with caulogloeocystidia,

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Figs. 1–8, *Gloiocephala resinopunctata* : 1, basidiomes X 3; 2, spores; 3, basidia; 4, basidioles; 5, cheilogloeocystidia; 6, elements of pileipellis; 7, pileogloeocystidia; 8, caulogloeocystidia; scale bar = 10 µm.


1
7
3
2
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8

similar to pileogloeocystidia in size and shape, outnumbering the normal vesiculose cells.

On decaying petioles of coconut palm (*Cocos nucifera* L.), gregarious or in dense troops but never caespitose, July-August.

Specimens examined: India, Kerala State, Kannur District, Pulikurumba: 20 July 1996, P. Manimohan M703a; 15 July 1997, P. Manimohan M703c; Malappuram District, Calicut University Campus: 14 July 1997, P. Manimohan M703b; 16 July 1997, P. Manimohan, M703d; 24 July 1997, P. Manimohan M703e (holotype); 28 July 1997, P. Manimohan M703f; 5 August 1997, P. Manimohan M703g. (all at SFSU).

Gloiocephala resinopunctata is characterised by a distinctive combination of features such as the very small, whitish, pleurotoid, stipitate basidiomes dotted with a reddish brown resin and apparently restricted to decaying petioles of coconut palm; the broadly ellipsoid to subamygdaliform spores; elongate basidia and fusoid basidioles both showing plenty of guttulate contents; the presence of abundant gloeocystidia on pileipellis, stipitipellis and lamella-edge; inamyloid hyphae; subgelatinized hymenophoral and pileal tramal hyphae; absence of metuloidal hairs on both pileus and stipe; and the brownish orange to rust brown colour as well as the varnished appearance of the exciccata. The absence of long metuloidal hairs on the pileus and stipe, the stipitate pileus, and the spores that are larger than 6 µm are indicative of sect. *Gloiocephala* Singer where the spore-size and the habitat place the new species in subsect. *Macrosporae* Singer. It seems to be closely related to *G. rubescens* (Segedin) Desjardin & Horak described from New Zealand. The colour of the pileus, the resin-exudation and the morphology and size of spores are strikingly similar in these two palmicolous species. *Gloiocephala rubescens*, however, is a somewhat larger species with companella-like macromorphology; conspicuous, concentric tessellate ridges on the pileal surface; almost poroid hymenophore; strongly gelatinized, cartilaginous context; and tibiiform gloeocystidia on both lamella-edge and pileipellis. Also, they seem to be restricted to different palm genera. The palmicolous basidiomes invite comparison with *G. palmarum* Singer known from the Amazonas region but apart from the habitat, there are no other significant similarities between the two species. The colour of the basidiomes, the size and shape of spores, the shape and nature of cystidia, the size of basidia, the presence of metuloidal hairs, and the absence of resin exudation make *G. palmarum* quite distinct. Resin exudation, one of the major distinguishing features of *G. resinopunctata*, is a feature shown by a few other species as well (Singer, 1960, 1976). Within the subsect. *Macrosporae*, this feature is shown by another species *G. inobasis* Singer which, however, has metuloidal cystidia, smaller basidia and an entirely different spore-shape. *Gloiocephala culmicola* Singer, another species of the subsection *Macrosporae* described from Ecuador and stated to be related to *G. palmarum* (Singer, 1989), differs from *G.*

resinopunctata in having orange basidiomes; very narrow, fusoid spores; much smaller basidia; metuloidal hairs on pileal surface; and graminicolous habitat.

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TAXONOMICAL STUDIES ON USTILAGINALES. XVIII. *

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ABSTRACT

The following groups of smut fungi were studied: the genus *Thecaphora*, which was emended including also *Sorosporium*; the smut fungi of Portulacaceae; *Schizonella* species of *Carex*, as well as some other smut fungi from different parts of the world.

NEW SPECIES proposed: *Melanotaenium gunnerae* G. P. Clinton ex K. Vánky & R. Bauer (type on *Gunnera magellanica*, Chile); *Microbotryum calyptratae* K. Vánky (type on *Calandrinia calyptrata* and *C. menziesii*, Australia, USA); *Microbotryum lewisiae* K. Vánky (type on *Lewisia nevadensis*, USA); *Microbotryum perfoliatae* K. Vánky (type on *Claytonia perfoliata*, USA); *Schizonella intercedens* K. Vánky & A. Nagler (type on *Carex michelii*, Hungary); and *Urocystis trautvetteriae* K. Vánky (type on *Trautvetteria grandis*, Canada).

NEW COMBINATIONS proposed: *Heterodoassansia callitrichis* (Jackson & Linder) K. Vánky, based on *Doassansia callitrichis* (type on *Callitriche marginata*); *Macalpinomyces tanakae* (S. Ito) K. Vánky, based on *Ustilago tanakae* (type on *Setaria italica*); *Thecaphora saponariae* (Rudolphi) K. Vánky, based on *Sorosporium saponariae* (type on *Saponaria officinalis*), and *Urocystis antarctica* (Spegazzini) K. Vánky, based on *Sorosporium antarcticum* (type on *Azorella glebaria*).

EXCLUDED SPECIES: *Ustilago(?) senecionis* Dietel & Neger is a myxomycete.

THE GENUS *THECAPHORA*, INCLUDING *SOROSPORIUM*

I proposed to unify *Thecaphora* Fingerhuth (1836) with *Sorosporium* Rudolphi (1829) and to conserve the name *Thecaphora* against the earlier *Sorosporium* (Vánky, 1998a, in press). The synonyms and the emended description of the genus *Thecaphora* are:

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Thecaphora Fingerhuth, 1836:230, emend. K. Vánky, nom. cons. prop. (1998).

Typus generis: *T. hyalina* Fingerhuth, 1836:230. — *Sorosporium hyalinum* (Fingerh.) Winter, 1881:105. — Type on *Convolvulus sepium* L., Germany.

Uredo seminis-convolvuli Desmazières, in Desm., Pl. crypt. Fr., ed. 1, No. 274, 1827. — *Thecaphora seminis-convolvuli* (Desm.) S. Ito, 1935:94. — Type on *Convolvulus arvensis* L., France, Dépt. Nord, Lille, leg. M. Nouel. Isotypi in Desm., Pl. crypt. Fr., ed. 1, No. 274, 1827 (HUV 2101!).

Sorosporium Rudolphi, 1829:116, nom. rej. prop. — Typus generis: *S. saponariae* Rudolphi, 1829:116. — *Thecaphora saponariae* (Rudolphi) K. Vánky, opus praesens. — Type on *Saponaria officinalis* L., Germany, near Heidelberg, leg. A. Braun (HBG).

Poikilosporium Dietel, 1897:87. — Typus generis: *P. davidsohnii* (Dietel & Holway) Dietel (= *Thecaphora pilulaeformis* Berk. & Curtis).

Sori in various parts of dicotyledonous host plants filled by masses of spore balls of yellowish- to dark reddish-brown colour, never black, and without a violet tint. Spore balls composed of few to many, loosely or firmly agglutinated spores. No sterile cells or hyphae are present in the spore balls, no spores of other type or differentiated sterile cells are present between the spore balls. Spore ball formation through differentiation within agglomerated sporogenous mass of hyphae; these hyphae are completely consumed for spore building. Spores subpolyhedrally irregular, often wedge-shaped. Spore wall thin, smooth or nearly so on the contact sides, thick and ornamented on the free side. Spore germination results in germ tubes (basidia?), often with basal swelling, initially aseptate later septate, with or without ramifications and conjugations, growing out as filaments producing apically or subapically ovoid or cylindrical, aerial "sporidia", often on terminal ramifications. Interaction with the host plants by intracellular hyphae. Mature septa are poreless.

The unification of the genera *Thecaphora* and *Sorosporium*, with the conservation of the name *Thecaphora* against the earlier *Sorosporium* means that *Sorosporium saponariae* has to be recombined into the genus *Thecaphora* as:

Thecaphora saponariae (Rudolphi) K. Vánky, **comb. nov.**

Basionym: *Sorosporium saponariae* Rudolphi, Linnea 4:116, 1829. — Type on *Saponaria officinalis* L., Germany, near Heidelberg, leg. A. Braun (HBG).

For descriptions and illustrations of *S. saponariae* and *T. seminis-convolvuli* see Vánky (1994). For germination of *S. saponariae* see Ingold (1987:473 + fig. 2), and for that of *T. seminis-convolvuli* see Woronin (1881(1882):577, Pl. III, figs. 19–28), and Nagler (1986:56–60, figs. 26–27).

In modern papers, this species is treated in a broad sense, parasitising many host plants of different caryophyllaceous genera. A critical, comparative work on these specimens is still lacking.

I recognise 44 species of *Thecaphora*, all restricted to dicotyledonous host plants. "*Thecaphora*" species on Gramineae (Vánky & Berbee, 1988) and on other monocotyledonous families (e.g. Cyperaceae, Liliaceae, Restionaceae) do not belong to this genus. The recognised *Thecaphora* species are:

On **Amaranthaceae** (4): *T. amaranthi* (Hirschh.) K. Vánky on *Amaranthus*; *T.*

haumanii Speg. on *Iresine*; *T. iresine* (Elliott) H. S. Jackson on *Iresine*; *T. thornberii* Griff. on *Cladothrix*. On **Boraginaceae** (1): *T. lithospermi* K. Vánky & Nannf. on *Lithospermum*. On **Caryophyllaceae** (1): *T. saponariae* (Rudolphi) K. Vánky (s. lat.) on *Cerastium, Dianthus, Lychnis, Minuartia, Moehringia, Petrorhagia, Saponaria, Silene, Stellaria* and *Tunica*. On **Compositae** (17): *T. ambrosiae* K. Vánky on *Ambrosia*; *T. burkartii* J. C. Lindq. on *Elvira*; *T. californica* (Harkness) G. P. Clinton on *Grindelia*; *T. cuneata* (Schofield) G. P. Clinton on *Grindelia*; *T. denticulata* Durán on *Bidens*; *T. heliopsidis* Durán on *Heliopsis*; *T. henneana* Durán on *Melampodium*; *T. lagenophorae* (McAlp.) McAlp. on *Lagenophora*; *T. melampodii* Durán on *Melampodium*; *T. mexicana* Ell. & Ev. on *Guardiola*; *T. neo-mexicana* Durán on *Baltimora*; *T. piluliformis* Berk. & Curtis on *Bigelowia*; *T. polymniae* K. Vánky & Pardo-Gardona on *Polymnia*; *T. pulcherrima* Durán on *Baltimora*; *T. pustulata* G. P. Clinton on *Bidens*; *T. spilanthes* F. C. O. Freire & K. Vánky on *Spilanthes*; *T. trailii* Cooke on *Carduus, Cirsium* and *Saussurea*. On **Convolvulaceae** (1): *T. seminis-convolvuli* (Desm.) S. Ito on *Calystegia* and *Convolvulus*. On **Leguminosae** (11): *T. affinis* Schneider ex Fischer von Waldh. on *Astragalus*; *T. deformans* Durieu & Mont. ex L.-R. & C. Tul. on *Medicago*; *T. desmodii* (Peck) Wor. on *Desmodium*; *T. frezzii* Carranza & J. C. Lindq. on *Arachis*; *T. hedysari* K. Vánky on *Hedysarum*; *T. lathyri* J. G. Kühn on *Lathyrus*; *T. loti* Mayor on *Lotus*; *T. lupini* Mayor on *Lupinus*; *T. trigonellae* Schwarzman on *Trigonella*; *T. viciae* Bubák on *Vicia*; *T. viciae-amoenae* Harada on *Vicia*. On **Molluginaceae** (1): *T. molluginis* T. Savul. on *Mollugo*. On **Nyctaginaceae** (1): *T. tunicata* G. P. Clinton on *Boerhavia*. On **Polygonaceae** (1): *T. schwarzmaniana* Byzova on *Rheum*. On **Primulaceae** (2): *T. androsacina* K. Vánky on *Androsace*; *T. oberwinkleri* K. Vánky on *Androsace*. On **Rubiaceae** (2): *T. hieronymi* Schröter on *Richardsonia*; *T. spermacoces* Thirum. & M. S. Pavgi on *Spermacoce*. On **Solanaceae** (1): *T. solani* (Thirum. & M. J. O'Brien) Mordue on *Lycopersicum* and *Solanum*. On **Umbelliferae** (1): *T. pimpinellae* Juel on *Pimpinella*.

THE SMUT FUNGI OF PORTULACACEAE

Five species of Ustilaginales have been described from Portulacaceae: **1.** *Microbotryum calandriniae* (G. P. Clinton) K. Vánky (type on *Calandrinia breweri* Watson, USA), **2.** *M. calandriniicola* (Speg.) K. Vánky (type on *Calandrinia affinis* Gill., Argentina), **3.** *M. claytoniae* (C. L. Shear) K. Vánky (lectotype on *Claytonia linearis* Dougl., USA), **4.** *M. nelsonianum* (Savile) K. Vánky (type on *Montia cordifolia* (S. Watson) Pax. & K. Hoffm., Canada), and **5.** *Tolyposporium montiae* (Rostr.) Rostr. (type on *Montia minor* C. C. Gmelin, Denmark). Of these, *T. montiae* turned out to be an ascomycete (Vánky, 1990:276). Checking smut fungus collections of Portulacaceae, a further three *Microbotryum* species could be distinguished.

In 1929, G. P. Clinton obtained a smut fungus on *Lewisia nevadensis* from Dr. Lee Bonard, under the name of *Ustilago calandriniae*. Clinton, in his letter to Bonard, acknowledged the specimen and, i.a., wrote that "it does not entirely resemble the type" (on *Calandrinia breweri*). However, Clinton did not continue

to investigate this specimen, which differs markedly from all known *Microbotryum* species on Portulacaceae. It is described as:

Microbotryum lewisiae K. Vánky, **sp. nov.**

Typus in matrice *Lewisia nevadensis* (Gray) Rob., USA, California, Lake Iahoe region, Mt. Iallac, 3.VII.1928, leg. M. S. Jussel, comm. L. Bonard (sub *Ustilago calandriniae* Clinton). Holotypus in BPI 159500!, isotypus in BPI 199492!

Sori in floribus totis, transformantes eos in corpora ovoidea, acuta, tumefacta, floribus tulipae plus-minus apertis similia, 4–7 x 5–9 mm, sporis complete farcta, primo residuis integumenti floralis vel epidermide matricis tantum sicut membrana tenui, argentea cooperta, qua dissoluta massam sporarum atro-rubrobrunneam, semiagglutinatam monstrantes. Sori etiam in caulium floralium tumefactam extendentes. Sporae globosae, subglobosae, late ellipsoidales, magis rarius ovoideae vel elongatae, 12–16(–17) x 12–17(–18) µm, violaceo colorate brunneae, leniter reticulatae, maculis rotundate polygonalibus, 7–11 per diametrum sporae, campi interni earum cum verruca parva 1 vel verrucis nonnullis ornati; muris in visu mediano sicut projectiones acutae, spiniformes, 1–2,5 µm altae apparentibus.

Sori (Fig. 1) in the whole flowers transforming them into ovoid, acute, swollen bodies resembling a more or less open tulip flower, 4–7 x 5–9 mm, completely filled with spores, first covered by remnants of floral envelopes or only of host epidermis as a thin, silvery membrane which flakes away disclosing the semi-agglutinated, dark purplish-brown mass of spores. Sori also extend into the swollen floral stems. Spores (Figs. 4, 5) globose, subglobose, broadly ellipsoidal, more rarely ovoid or elongated, 12–16(–17) x 12–17(–18) µm, violet tinted brown, finely reticulate, meshes rounded polygonal, 7–11 per spore diameter, interspaces with one or several small warts; muri in median view appear as 1–2.5 µm high, acute, spiny projections.

On Portulacaceae: *Lewisia nevadensis* (Gray) Rob. (*Calandrinia nevadensis* Gray; *Oreobroma nevadense* (Gray) Howell). Known from the type collection only.

Microbotryum lewisiae differs from *M. calandriniae* (type on *Calandrinia breweri*, USA) especially in the localisation of the sori, in the spore measurements, number of meshes per spore diameter and in the characters of the muri. The sori of *M. calandriniae* are in the seeds, the spores are 15–20(–21) µm long, the number of meshes per spore diameter is 4–8, in median view the muri appear as 2.5–4(–5) µm high, blunt projections.

Microbotryum calyptratae K. Vánky, **sp. nov.**

Typus in matrice *Calandrinia calyptrata* Hooker fil., Australia, Victoria, Rainbow, 35°56' S, 142°01' E, 22.X.1908, leg. D. McAlpine (sub *Ustilago calandriniae*). Holotypus in VPRI 3080!, isotypi in BPI 159496! et in HUV 18344! Paratypi in matrice *Calandrinia calyptrata* Hooker fil., Australia, Victoria, Kirchheim pr. Minyip, 11.XI.1897 & X.1898, leg. Eckert (sub *Ustilago calandriniae*), VPRI 8882! (isoparatypi in VPRI 3079!, 8883! et in HUV 18348!); Victoria, Myrniong, 12.XI.1934, leg. C. C. Brittlebank (sub *Ustilago calandriniae*), BPI 159494!; in matrice *Calandrinia menziensii* Torr. & Gray,

USA, California, W. Conta Costa Co., San Pablo Ridge, N.W. of Bald Peak, 22.IV.1930, leg. J. T. Howell (sub *Ustilago calandriniae*), BPI 159498!
Sori in floribus tumefactis, deformatis, in capsulis juvenilibus tantum, vel etiam duo sepala occupantes, sed caules florales non. Sori sicut flos tulipae, 2–3 mm diametro, primo residuis involucri floralis et membrana tenui capsulae cooperti, qua irregulariter rupta massam sporarum atram, purpureobrunneam, pulveream ostendentes. Sporae subglobosae, ovoideae, ellipsoidales usque parum irregulares, 12–16 x 13–19 µm, purpureobrunneae, subtiliter reticulatae, maculis 6–10(–11) polygonalibus in diametro sporae, interstitiis cum verrucis parvis nonnullis, muris in visu mediano sicut projectionibus 1,5–2,5 µm altis, apice complanatis apparentibus. Germinatio sporarum (McAlpine, 1910:153, tab. 53, fig. 206) cum basidiis tenuibus usque 4-septatis, 80–90 µm longis, lateraliter et terminaliter basidiosporas producentibus.

Sori (Fig. 2) in swollen, deformed flowers, restricted to the young capsules or also comprising the two sepals, but not extending to the floral stems. The sori resemble a tulip flower, are 2–3 mm in diameter, first covered by remnants of floral envelopes and a thin membrane of the capsule which ruptures irregularly disclosing the dark, purplish-brown, dusty mass of spores. Spores (Figs. 6, 7) subglobose, ovoid, ellipsoidal to slightly irregular, 12–16 x 13–19 µm, purplish-brown, finely reticulate, 6–10(–11) polygonal meshes per spore diameter, interspaces with several small warts, muri in median view appear as 1.5–2.5 µm high projections with a flattened top. Spore germination (McAlpine, 1910:153, Pl. 53, fig. 206) results in slender, up to 4-septate, 80–90 µm long basidia on which, laterally and terminally, basidiospores are produced.

On Portulacaceae: *Calandrinia calyptrata* Hooker fil., *C. menziesii* Torr. & Gray and *C. volubilis* Benth, Australia, USA.

Seen in median view, muri of spores of *Microbotryum calyptratae* are flat-topped, whereas muri of *M. lewisiae* are spiny. *M. calyptratae* differs from *M. claytoniae* especially in the localisation of the sori and by the presence of several warts within the meshes. In *M. claytoniae*, the sori are restricted to the seeds and no warts, or only a central protuberance, can be seen within the meshes. *M. calyptratae* differs from *M. calandriniae* mainly in the localisation of the sori and in the measurements of the muri. In *M. calandriniae* the sori are restricted to the seeds, the spores are 15–20(–21) µm long, and the blunt muri are 2.5–4(–5) µm high.

Microbotryum perfoliatae K. Vánky, **sp. nov.**
Typus in matrice *Claytonia perfoliata* (Don) Howell, USA, Oregon, Union Co., 5 mi. S. urbe La Grande, 15.VI.1963, leg. J. Burleigh (sub *Ustilago claytoniae*). Holotypus in WSP 51747!, isotypus in HUV 18347!

Sori in seminibus, capsulas parvas (1,5–2 mm in diametro) massa purpureonigra, pulverea sporarum implentes; capsulis apertis illae dispersae, residua seminum abortivorum sporis cooperta relinquentes. Sporae globoseae, subglobosae, late ellipsoidales vel ovoideae, raro elongatae vel parum irregulares, 10–14 x 11–15(–16) µm, violaceobrunneae, subtiliter reticulatae, maculis 5–10(–11) polygonalibus in diametro sporae, verrucis nullis, muris in visu mediano 1–1,5 µm altis, obtusis.

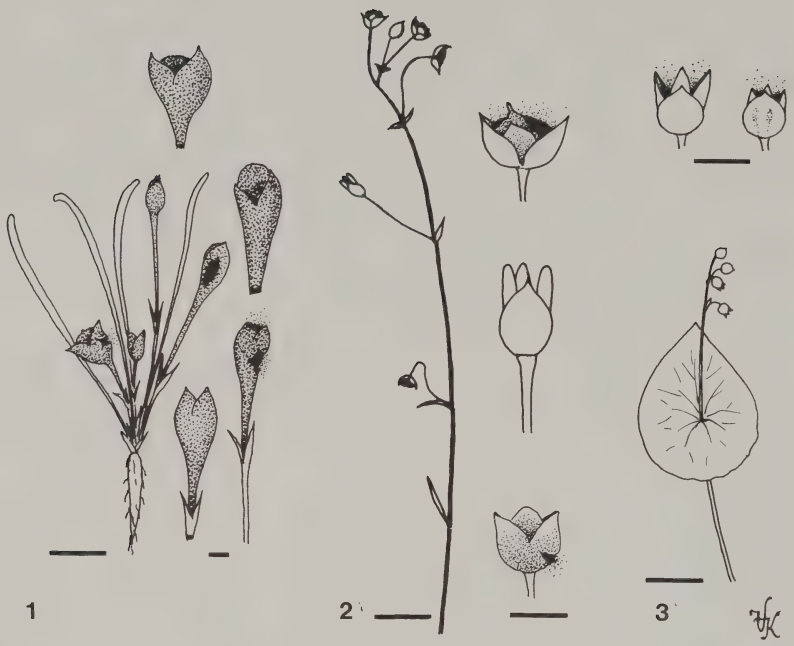


Fig. 1. Sori of *Microbotryum lewisiae* K. Vánky in the flowers, including the two, swollen sepals and also the floral stems of *Lewisia nevadensis* (Gray) Rob. Enlarged four sori (type).

Fig. 2. Sori of *Microbotryum calyptratae* K. Vánky in the flowers, sometimes including also the two sepals but not the floral stems of *Calandrinia calyptrata* Hooker fil. Enlarged two soi and (on the middle) a healthy flower with a ripe, open capsule with three valves (type).

Fig. 3. *Microbotryum perfoliatae* K. Vánky develops its spores in the seeds of *Claytonia perfoliata* (Don) Howell. Enlarged two flowers with intact sepals and with the tips of the three valves of the opened, intact capsule, releasing the spores (type). Bars = 1 cm, and for the detail pictures 2 mm.

Figs. 4, 5. Spores of *Microbotryum lewisiae* K. Vánky in LM and in SEM (type).

Figs. 6, 7. Spores of *Microbotryum calyptratae* K. Vánky in LM and in SEM (type).

Figs. 8, 9. Spores of *Microbotryum perfoliatae* K. Vánky in LM and in SEM (type). Bars = 10 µm.

Sori (Fig. 3) in the seeds, filling the small capsules (of 1.5–2 mm diam.) with a purplish-black, powdery mass of spores which are dispersed when the capsules open, leaving behind the remnants of the aborted seeds covered by spores. Spores (Figs. 8, 9) globose, subglobose, broadly ellipsoidal or ovoid, rarely elongated or slightly irregular, 10–14 x 11–15(–16) µm, violet-brown, finely reticulate, 5–10(–11) polygonal meshes per spore diameter, warts are lacking, muri in median view 1–1.5 µm high, blunt.

On Portulacaceae: *Claytonia perfoliata* (Don) Howell. Known from the type collection only.

Microbotryum perfoliatae differs from *M. calandriniae* and *M. claytoniae*, which have sori also in the seeds, especially by smaller spores and lower muri. In *M. calandriniae* the spores are 15–21 µm long and the muri 2.5–5 µm high. In *M. claytoniae* the spores are 13–19 µm long and the muri 1–2.5 µm high.

The main differentiating characters of the smut fungi (*Microbotryum* species) of Portulacaceae are summarised in the following key.

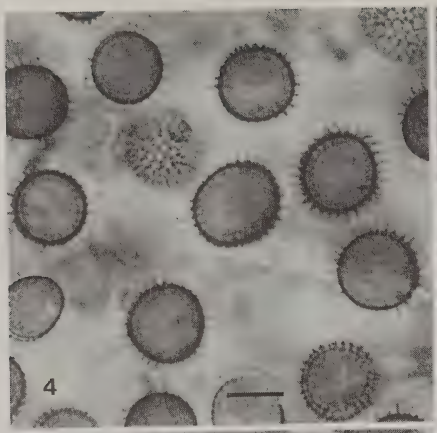
1. Sori comprise the whole flowers 2
– Sori do not comprise the whole flowers 3
2. Sori comprise also the floral stems. Muri acute, 1–2.5 µm high. On *Lewisia* .... *M. lewisiae*
– Sori restricted to the flowers or to the capsules only. Muri flattened, 1.5–2.5 µm high. On *Calandrinia* ..... *M. calyptratae*
3. Sori in the anthers 4
– Sori in the seeds 5
4. Spores (5–)6–8 µm long. On *Calandrinia* ..... *M. calandriniicola*
– Spores 11–18.5 µm long. On *Montia* ..... *M. nelsonianum*
5. Spores 15–21 µm long. Meshes per spore diam. 4–8. Muri 2.5–5 µm high. On *Calandrinia* ..... *M. calandriniae*
– Spores smaller. Meshes per spore diam. 5–11. Muri lower. On *Claytonia* 6
6. Spores 13–19 µm long. Muri 1–2.5 µm high ..... *M. claytoniae*
– Spores 11–15(–16) µm long. Muri 1–1.5 µm high ..... *M. perfoliatae*

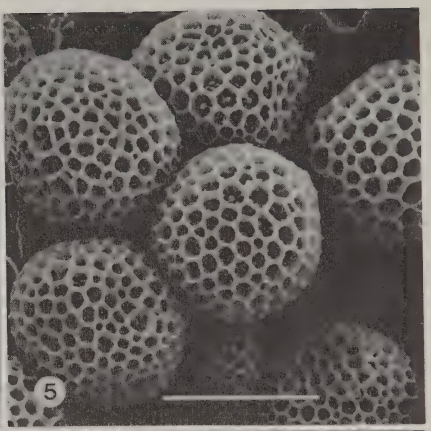
A NEW SPECIES OF *UROCYSTIS* ON *TRAUTVETTERIA* (RANUNCULACEAE)

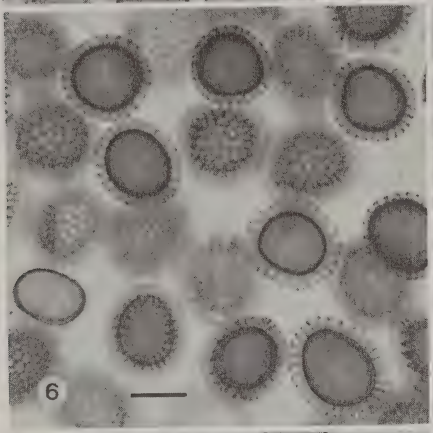
Urocystis trautvetteriae K. Vánky, **sp. nov.**

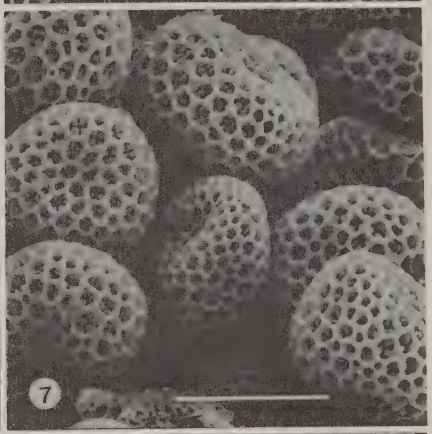
Typus in matrice *Trautvetteria grandis* Nutt. (*T. carolinensis* (Walt.) Vail. var. *occidentalis* (Gray) C. L. Hitch.), Canada, British Columbia, Vancouver I., 4 mi. N. Sarita, ad ripam fluminis Sarita, 48°54' N, 125°00' W, 12.VI.1961, leg. J. A. Calder (30353) & K. T. MacKay. Holotypus in Herbario Ustilag. Vánky (HUV 9944), isotypus in DAOM (145082, sub *Urocystis* affin. *sorosporoides* Körn.).

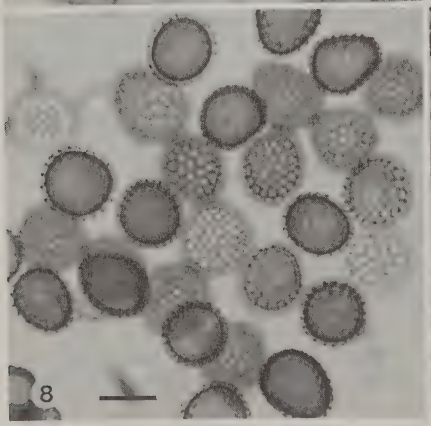
Sori sicut intumescentiae pustuliformes plerumque foliorum aversorum vel petiolorum cauliumque, 1 mm usque 3 cm longae vel longiores propter confluentiam formati, initio epidermide cooperti, illo irregulariter rupto massam nigrobrunneam, pulveream glomerulorum sporarum ostendentes. Glomeruli sporarum globoidei, ovoidei vel irregulares, 20–35 x 20–45 µm, e sporis 1–4(–5)


4


5


6


7


8

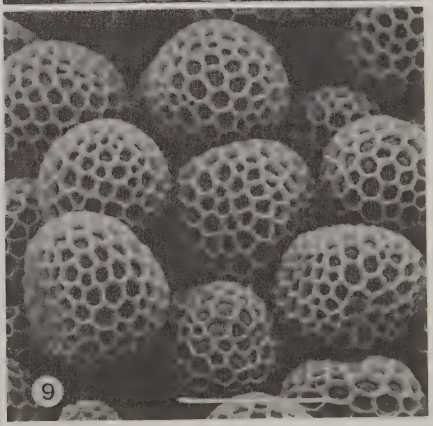

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Fig. 10. Sori of *Urocystis trautvetteriae* K. Vánky on a leaf and a petiole of *Trautvetteria grandis* Nutt., and two flowers (type). Bar = 1 cm.

compositi, strato imperfecto, cum exceptione perfecto cellularum sterilium circumdati, vel cellulis sterilibus absentibus. Raro sporae nullae et cellulae steriles tantum glomerulos formantes. (Sporae glomerulorum sporarum: 0=1%, 1=42%, 2=44%, 3= 9,5%, 4=3%, 5=0,5%). Sporae subglobosae, plerumque ovoideae vel parum irregulares lateribus deplanatis, vel elongatae, 12–16 x 13,5–21(–25) µm, rubrobrunneae, contentu leniter granuloso; pariete cca. 1 µm crasso, levi. Cellulae steriles forma, magnitudine et crassitudine parietis variae, ovoideae, elongatae, vel plerumque irregulares cum lateribus deplanatis, 8–21(–25) µm longae, flavidobrunneae; pariete (1–)1,5–2,5(–3) µm crasso, levi.

Sori (Fig. 10) as blister-like swellings, usually on the abaxial side of the leaves or on the petioles and stems, from 1 mm to 3 cm or longer by confluence, initially covered by the epidermis which ruptures irregularly to expose the blackish-brown, powdery mass of spore balls. Spore balls (Figs. 11, 12) globoid, ovoid or irregular, 20–35 x 20–45 µm, composed of 1–4(–5) spores surrounded by an incomplete, rarely complete layer of sterile cells, or sterile cells are lacking. Seldom, spores are lacking and only sterile cells are forming a ball (Spores per spore ball: 0=1%, 1=42%, 2=44%, 3= 9.5%, 4=3%, 5=0.5%). Spores (Figs. 11, 12) subglobose, usually ovoid or slightly irregular with flattened sides, or elongate, 12–16 x 13.5–21(–25) µm, reddish-brown, with finely granular content; wall c. 1 µm thick, smooth. Sterile cells (Figs. 11, 12 variable in shape, size and wall thickness, ovoid, elongated or usually irregular with flattened sides, 8–21(–25) µm long, yellowish-brown; wall (1–)1.5–2.5(–3) µm thick, smooth.

On Ranunculaceae: *Trautvetteria grandis* Nutt., N. America (Can., USA).

More than 30 *Urocystis* species are known on members of the Ranunculaceae family. These are morphologically different, infecting one or several host plant species within the same genus. The large genus *Ranunculus* is parasitised by at least 8 *Urocystis* species. (There is no comparative, monographic work on this group of smut fungi). *Urocystis trautvetteriae* was thought to be *U. sorosporioides* Körn. ex Fischer v. Waldh. (type on *Thalictrum minus* L., Germany). However, in *U. sorosporioides* the spore balls are composed of 1–10(–12) spores and these are completely or nearly completely invested by sterile cells. The genus *Trautvetteria* was separated from *Cimicifuga*, which is parasitised by *Urocystis carcinodes* (Berk. & Curtis) Fischer v. Waldh. (type on *Cimicifuga racemosa* (L.) Nutt., USA). In *U. carcinodes* the spore balls are composed of (1–)2–8(–10) spores and are completely invested by sterile cells.

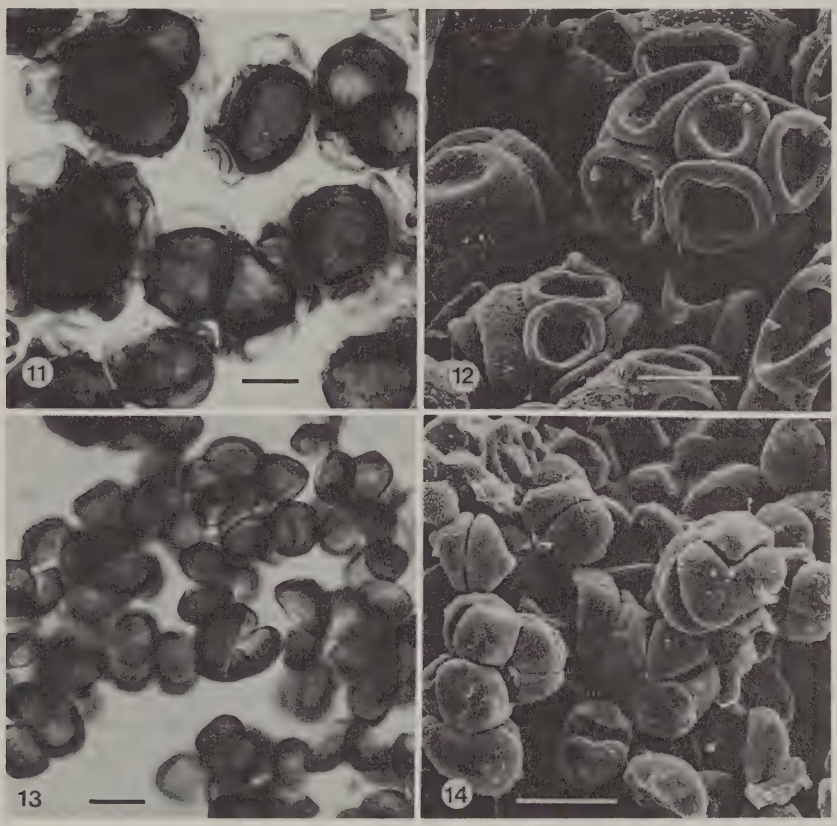
SCHIZONELLA SPECIES OF *CAREX*

Of the four recognised *Schizonella* species two parasitise *Carex* species. A third species on *Carex* is described below.

1. ***Schizonella melanogramma*** (DC.) Schröter (lectotype on *Carex digitata* L., France). It is characterised by sori in the leaves and stems usually as epiphyllous, black, bullate streaks of various length, containing the semi-agglutinated, later almost powdery spore masses. Spores usually in pairs and connected on their contact sides as a result of the only partial division of the spore mother cell, subglobose, ovoid, usually irregularly hemispherical, 5–9(–10) x 8–13(–15) µm,

olivaceous-brown; spore wall smooth, rough to finely verruculose, usually thinner and lighter on the contact sides. Germination results in a four-celled basidium (of 3 + 1 arrangement, where the proximal cell remains in the spore, the distal, three-celled part normally is detached), laterally and terminally bearing ovoid to elongated basidiospores.

2. ***Schizonella cocconii*** (Morini) Liro (type on *Carex flacca* Schreber, Italy). In its appearance it is similar to *S. melanogramma* but it has spore balls composed of up to 20 (or more) spores, more or less readily separating into single spores or pairs of spores.



Figs. 11, 12. Spore balls of *Urocystis trautvetteriae* K. Vánky in LM and in SEM. The balls are composed of one or several spores and an incomplete layer of peripheral sterile cells. In dried, old specimens the thin-walled sterile cells are usually collapsed (type).

Figs. 13, 14. Paired spores and small spore balls of *Schizonella intercedens* K. Vánky & A. Nagler in LM and in SEM (type). Bars = 10 µm.



Fig. 15. Sori of *Schizonella intercedens* K. Vánky & A. Nagler in the leaves of *Carex michelii* Host (type). Bar = 1 cm.

Several years ago, studying European *Schizonella* collections from *Carex*, it was realised that there are some specimens which are difficult to assign to one of the two known *Schizonella* species on this host genus, and it was believed that these specimens belong to a separate species. Germination and culture characters supported this assumption. It is described as:

Schizonella intercedens K. Vánky & A. Nagler, **sp. nov.**

Typus in matrice *Carex michelii* Host, Hungaria, Comit. Borsod-Abaúj-Zemplén, prope pag. Szinpetri, 48°29'30" N, 20°36'25" E, alt. ca. 220 m, 21.V.1987, leg. J. Gönczöl, E., U. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 18343), isotypi in Vánky, Ust. exs. (inedited), Herb. A. Nagler 721 and BPI. Paratypus in matrice *Carex michelii* Host, Hungaria, Comit. Pest, 15 km NW Budapest, Mt. Nagyszénás, 30.V.1987, leg. N. Lundqvist (16621), HUV 18346.

Sori in foliis, plerumque adaxiali, primo sicut striae nigrae, bullatae, durae, intraepidermales, 0,3–0,5 x 1–10 mm, vel propter coalescentiam longiores formati, serius cellulae epidermales ruptae massam sporarum nigrobrunneam, semipulveream ostendentes. Sporae binae vel 3–6 earum in gregibus parvis dispositae. Sporae singulae forma et magnitudine variae, raro hemisphaericae, plerumque elongatae, irregulares, subangulares, latere contactus plus-minus plano et latere libero rotundato, nonnumquam cum acie acuto vel subacuto inter conjunctas sporas sporarum geminarum; 5–9,5 x 8–13(–14,5) µm, olivaceo-brunneae; pariete lateris contactus dilutiore, cca. 0,5 µm crasso, illo lateris liberi obscuriore, 1–1,5(–2,5) µm crasso, in angulis maxime crasso, levi. Germinatio sporarum per phragmobasidia (plerumque dispositione 3 + 1, ubi cellula proximalis in spora clausa manens) in quibus ad sterigmata lateraliter et apicaliter basidiosporae longe ellipsoidales, magnitudine 2,5–4 x 8–20 µm productae.

Sori (Fig. 15) in the leaves, usually adaxial, first as black, blister-like, hard, intraepidermal striae, 0.3–0.5 x 1–10 mm or longer by confluence, later the epidermal cells burst revealing the blackish-brown, semi-powdery mass of spores. Spores (Figs. 13, 14) in pairs or in small groups of 3–6. Single spores variable in shape and size, rarely hemispherical, usually elongated, irregular, subangular, with a more or less flattened contact side and a rounded free side, sometimes with a subacute or acute ridge between the two halves of the spores, 5–9.5 x 8–13(–14.5) µm, olivaceous brown; wall lighter coloured on the contact half, c. 0.5 µm thick, darker on the free half, 1–1.5(–2.5) µm thick, thickest at the angles, smooth. Spore germination (Fig. 16.) results in phragmobasidia (usually of 3 + 1 arrangement, where the proximal cell remains included in the spore), on which laterally and apically, on sterigmata, long ellipsoidal basidiospores are produced, measuring 2.5–4 x 8–20 µm.

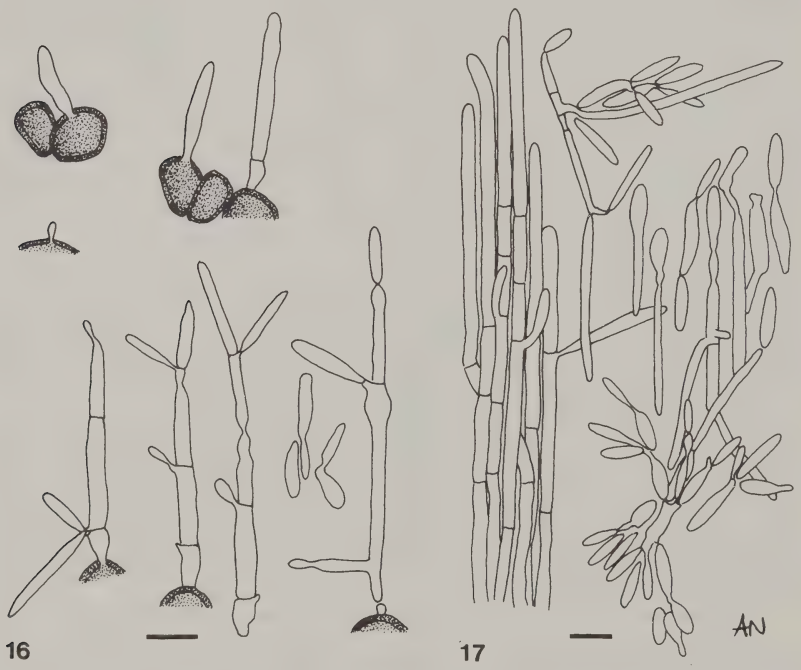
On Cyperaceae: *Carex michelii* Host, E. Europe (Au, Bu, Cz, Hu, Ju, Ro, Sl).

The difference between the three *Schizonella* species on *Carex* lies not only in the fact that in *S. cocconii* the spores are agglutinated in spore balls, in *S. melanogramma* the spores are in pairs, and in *S. intercedens* the spores are in pairs and also in small groups, but there are also differences in the morphology of the basidia and the basidiospores, and in the cultures of these three species, as can be seen in figures 16, 18, 20, and 17, 19, 21, respectively.

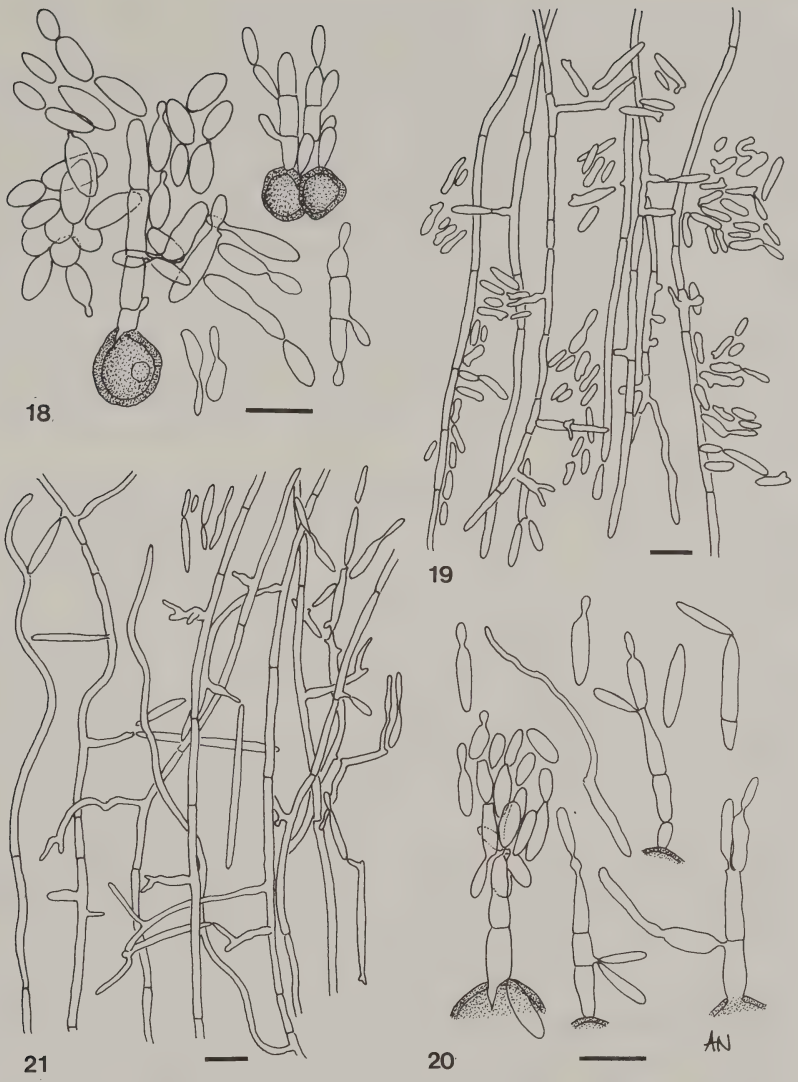
It is intersting to note that one *Carex* species may be parasitised by more than one *Schizonella* species; e.g., *S. melanogramma* was collected in Bulgaria (SOM 8849-M) on *Carex halleriana* Asso, a sedge which usually takes *S. cocconii*. On the other hand, *S. melanogramma* can infect several *Carex* species.

Key to the *Schizonella* species.

1. Sori on the stems of *Isolepis* ..... *S. isolepidis*
– Sori on the leaves. Not on *Isolepis* 2
2. Spores light brown, 6–11 µm long. On *Kobresia* (*Elyna*) spp..... *S. elynae*
– Spores mostly dark brown, 8–15 µm long. On *Carex* spp..... 3
3. Spores in irregular spore balls ..... *S. cocconii*
– Spores in pairs or in small groups 4
4. Spores in pairs. Basidiospores mostly ovoid..... *S. melanogramma*
– Spores in pairs and in small groups. Basidiospores mostly long ellipsoidal ..... *S. intercedens*



Figs. 16–17. *Schizonella intercedens* K. Vánky & A. Nagler from *Carex michelii*.
Fig. 16. Germinating spores (on WA, at room temp., 2–3 days; AN 721).
Fig. 17. Septate mycelia on which yeast-like cells are produced which bud (3 weeks old culture on MYP, at room temp.; AN 721). Bars = 10 µm.



Figs. 18–19. *Schizonella melanogramma* (DC.) Schröter from *Carex firma*.
Fig. 18. Germinating spores (on WA, at room temp., 2–3 days; AN 810).
Fig. 19. Septate mycelia on which yeast-like cells are produced which bud (3 weeks old culture on MYP, at room temp.; AN 810).
Figs. 20–21. *Schizonella cocconii* (Morini) Liro from *Carex halleriana*.
Fig. 20. Germinating spores (on WA, at room temp., 2–3 days; AN 704).
Fig. 21. Septate mycelia on which yeast-like cells are produced which bud (3 weeks old culture on MYP, at room temp.; AN 704). Bars = 10 μm.

A NEW SPECIES OF *MELANOTAENIUM* ON *GUNNERA* (HALORAGACEAE)

Between unfinished manuscripts on the Ustilaginales of the outstanding North American mycologist Dr. George Perkins Clinton (1867–1937), G. L. Zundel found the description of a new species of *Ustilago* on *Gunnera magellanica*, written in June 1932. Zundel (1938:679) published, invalidly (without Latin description, ICBN 36.1), *Ustilago gunnerae* G. P. Clinton. However, species of *Ustilago* (Pers.) Roussel, s. str., are restricted to monocotyledonous host plants and differ essentially from smut fungi on dicotyledonous host plants (currently classified into 25 genera). Most *Ustilago*-like species on dicotyledonous host plants belong to the genus *Microbotryum* with 72 known species on 9 host plant families (Vánky, 1998b, in press). Common for *Microbotryum* species is, i.a., the violet tint of the spores. The spores of "*Ustilago*" *gunnerae* lack this violet tint, and because of the peculiar sorus, spore morphology, and the unusual host plant family, we investigated this fungus. It turned out to be a member of the genus *Melanotaenium*.

Melanotaenium gunnerae G. P. Clinton ex K. Vánky & R. Bauer, **sp. nov.**
Ustilago gunnerae G. P. Clinton, in Zundel, 1938:679, nomen nudum (without Latin diagnosis). — Typus in matrice *Gunnera magellanica* Lam. (Haloragaceae), Chile, Magellanes, Punta Arenas, II.1906, R. Thaxter. Holotypus in Herbario Ustil. Vánky (HUV 3706!), isotypi in Rel. Farlow. No. 951.

Sori intumescentiae in petiolis et in venis faciei abaxialis foliorum conspicuae, plerumque fusiformes, millimetris nonnullis latae et usque 1 cm longae, massa sporarum atro-rubrobrunnea, sat agglutinata, texturis hospitis mixta repletae. Sporae subglobosae, ovoideae, elongatae usque parum irregulares, interdum guttaeformes breviter apiculatae et simul cum papilla hyalina, 10,5–13 x 11–20 (–22,5) µm, flavidobrunneae usque rubrobrunneae; pariete levi, bistratoso, strato interno aequali, cca. 1 µm crasso, brunneo, strato externo inaequali, a valde tenui passim usque ad 2 µm crasso, hyalino, plerumque ad angulos papillam/papillas formante. Germinatio ignota. Conjunctio inter matricem et parasitum per hyphas intercellulares cum haustoribus. Septa cum poris simplicibus cum duobus membranis, taeniae nonmembranaceae interiores porus ocludentes absentes.

Sori (Figs. 22, 23, 24) as swellings on the petioles and also in the veins, evident on the abaxial side of the leaves, usually fusiform, a few mm wide and up to 1 cm long, filled with a dark reddish-brown, rather agglutinated mass of spores intermixed with host plant tissues. Spores (Figs. 25, 26) subglobose, ovoid, elongated to usually slightly irregular, sometimes tear-shaped with a short apiculum and also with a hyaline papilla, 10.5–13 x 11–20(–22.5) µm, yellowish-brown to reddish-brown; wall smooth, two-layered, inner layer even, c. 1 µm wide, brown, outer layer uneven, from very thin to locally up to 2 µm wide, hyaline, forming papilla/ae usually at the angles. Germination unknown. Host–parasite interaction by intercellular hyphae with haustoria (Fig. 27). Septa with simple pore enclosed by two membranes. Inner, nonmembranous bands closing the pore are lacking (Fig. 28).

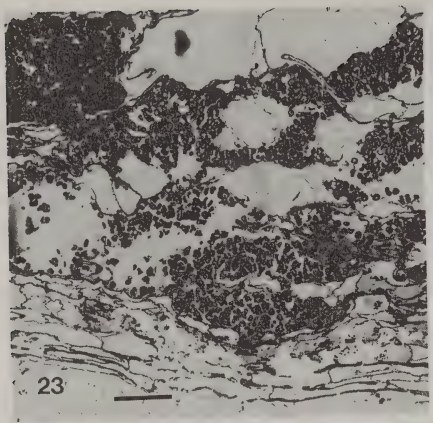
On Haloragaceae: *Gunnera magellanica* Lam., S. America (Chile).



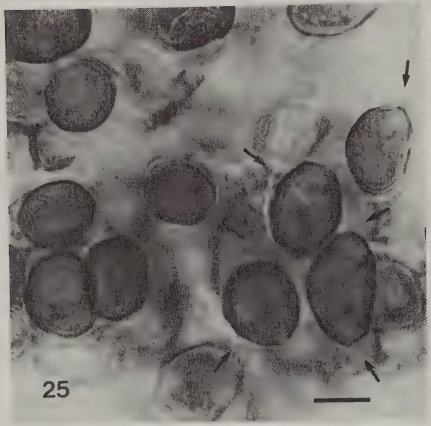
Fig. 22. Sori of *Melanotaenium gunnerae* G. P. Clinton ex K. Vánky & R. Bauer on the petiole and leaf veins of *Gunnera magellanica* Lam. (type). Bar = 1 cm.

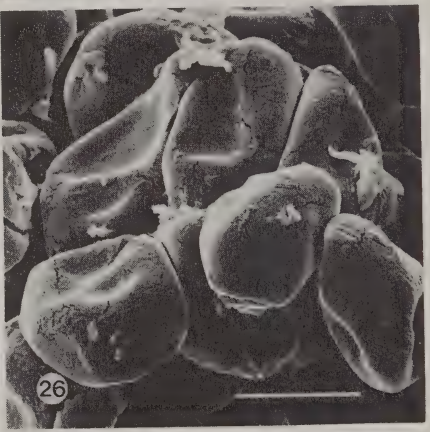
Melanotaenium gunnerae is the sole known smut fungus on a member of the Haloragaceae. Moreover, on members of the 17 families of the Myrtiflorae (Myrtales), enumerated in Engler's book (Melchior, 1964:345-366), beside *M. gunnerae*, only four smut fungi have been reported: **1**. *Entyloma eugeniarum* Cooke & Massee (on *Eugenia* sp., Myrtaceae), **2**. *Heterodoassansia punctiformis* (Winter) K. Vánky (on *Lythrum* spp., Lythraceae), **3**. *Doassansia epilobii* Farlow, and **4**. *Microbotryum gayophitii* (Harkness) K. Vánky (on *Epilobium* and *Gayophitum* species, respectively, Onagraceae).

A smut fungus which superficially resembles *M. gunnerae*, is *Ustacystis waldsteiniae* (Peck) Zundel on *Waldsteinia* and *Geum* species (Rosaceae; comp. Vánky, 1987:124). However, in *U. waldsteiniae* the sori are formed exclusively in the leaf veins, they are not swollen, when ripe dusty, the spores are single, in pairs or in loose, few-spored balls, haustoria are present, but the simple septal pore (with two outer membrane caps) in addition has also two inner nonmembranous bands closing the pore, which are lacking in the true *Melanotaenium* species (Bauer et al., 1997).

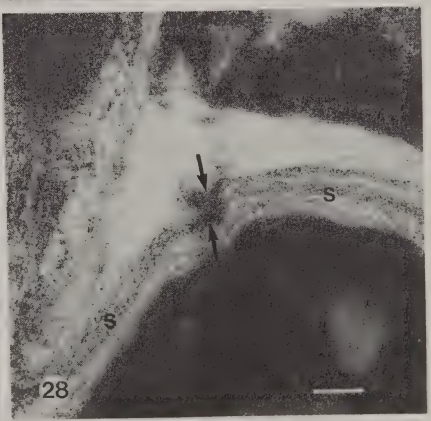

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NEW COMBINATIONS

AN ADDITIONAL SPECIES OF *HETERODOASSANSIA*

The genus *Heterodoassansia* K. Vánky (1993:28) was described for *Doassansia*-like smut fungi in which the sterile, cortical layer of the spore balls is heterogeneous. It is composed of an external layer of small, smooth, sterile cells and an internal layer of larger, empty sterile cells which are internally ornamented, i.e. provided with warts or spines on their inner surface. Until now four species of *Heterodoassansia* have been reported. Studies of the description and excellent illustrations of *Doassansia callitrichis* Jackson & Linder, in Linder (1938:669-670, Fig. 10), as well as studies of the type specimen showed that this smut fungus also belongs to the genus *Heterodoassansia.*

Heterodoassansia callitrichis (Jackson & Linder) K. Vánky, **comb. nov.**
Basionym: *Doassansia callitrichis* Jackson & Linder, in Linder, Mycologia 30:669, 1938 (as "*callitriches*"). — Type on *Callitriche marginata* Torr. var. *longipedunculata* (Mor.) Jepson, USA, California, Los Angeles, San Jose Hills, Puddingstone Dam, 34°06' N, 118°24' W, alt. 1000 ft., 17.III.1934, L. C. Wheeler (2448), TRTC 52073!, FH.

Sori as illdefined spots on the leaves and stems in which scattered spore balls are produced in the mesophyll of the leaves or the cortex of the stems, appearing as small, dark brown, elevated dots. Spore balls globose to ellipsoidal, 140–170(–240) µm in diameter, composed of a central mass of spores surrounded by a cortex of two kinds of sterile cells. Spores subglobose to subpolyhedrally irregular, 9.5–13 x 12.5–16 µm, colourless or slightly yellowish, with thin (0.5–1 µm), smooth wall. The cortex of sterile cells is composed of an inner layer of relatively large, 6–15 x 8–20(–24) µm, empty, thick-walled (1–3 µm), pale yellowish-brown, subglobose, ellipsoidal to usually subpolyhedrally irregular cells which are prominently verrucose-echinulate on their internal surface. The external part of the cortex is composed of small (2–6 µm long), empty, thin-walled (c. 0.5 µm), smooth sterile cells, usually collapsed, arranged in one or several layers.

Figs. 23–28. *Melanotaenium gunnerae* G. P. Clinton ex K. Vánky & R. Bauer (type).
Figs. 23, 24. TS of a sorus with groups of spores partly separated by host tissues. Bars = 100 µm and 10 µm, respectively.
Figs. 25, 26. Spores in LM and in SEM. In LM picture, hyaline, papilla-like thickenings of the exospore can be seen (arrows). Bars = 10 µm.
Fig. 27. Sectioned haustorium (h) with several lobes (arrows), spores (sp) and host cell wall (arrow heads) in TEM (Photo R. Bauer). Bar = 2 µm.
Fig. 28. Simple septal pore enclosed by two membranes (arrows) in TEM (the membranes are collapsed because old herbarium material was used), s = septum (Photo R. Bauer). Bar = 0.1 µm.

A FURTHER SPECIES OF *MACALPINOMYCES*

Studies of different grass smuts gradually resulted in the recognition of ten species of *Macalpinomyces* Langdon & Fullerton, and in the emendation of this genus, including also *Endosporisorium* K. Vánky (Vánky, 1995, 1996, 1997a, 1997b, 1997c). A specimen of *Ustilago tanakae* S. Ito, obtained in exchange from HMAS, also shows characters of *Macalpinomyces*.

Macalpinomyces tanakae (S. Ito) K. Vánky, **comb. nov.**

Basionym: *Ustilago tanakae* S. Ito, Trans. Sapporo Nat. Hist. Soc. 14:87, 1935. — *Sphacelotheca tanakae* (S. Ito) Zundel, 1953:208. — Type on *Setaria italica* (L.) Beauv. var. *germanica* (Mill.) Schrader, Japan, Hokkaido, Ishikari Prov., Maruyama near Sapporo, 24.IX.1927, leg. I. Tanaka.

Sori in scattered ovaries, inconspicuous, hidden by the floral envelopes, ovoid, c. 1–1.5 x 2 mm, covered by a brown peridium which ruptures irregularly disclosing the dark reddish-brown, granular mass of irregular groups of spores intermixed with sterile cells. Spores subglobose, ovoid to usually subpolyhedrally irregular, 8–10 x 9–12 µm, yellowish-brown; wall even, c. 1 µm thick, including the densely situated, evident, c. 0.5 µm high spines. Sterile cells single or in small groups, subglobose, ellipsoidal to irregular, collapsed in old specimens, (10–)12–28 µm long, hyaline to pale yellow; wall thin (0.5–1 µm), smooth.

On Gramineae: *Setaria italica* (L.) Beauv., and its var. *germanica* (Mill.) Schrader, *Setaria viridis* (L.) Beauv., East Asia (China, Japan).

I did not see the type specimen of *Macalpinomyces tanakae*, nor this fungus on *Setaria viridis*, only a specimen from China (Jilin Prov., IX.1987, coll. J.-K. Bai & M.-Y. Cheng, det. L. Guo, HMAS 73766, = HUV 18301!) on *Setaria italica*, which agrees with the description and illustration (in Ito, 1936:20, fig. 15) of this species, except for the somewhat smaller spore measurements obtained by me. In the original description the spores are 8–15 µm diam.

M. tanakae is the second species of *Macalpinomyces* on *Setaria* besides *M. sharmae* K. Vánky (holotype on *Panicum sumatrense* Roth ex Roem. & Schult., India, paratype on *Setaria pallide-fusca* (Schumacher) Stapf & C. E. Hubb., India). These two species, however, differ in spore and sterile cell morphology. In *M. sharmae*, the spores are smaller (7–11 µm long) and densely punctate-verruculose, and the sterile cells are 11–17 µm long.

Key to the recognised *Macalpinomyces* species.

1. Sori in the ovaries 2
– Sori elsewhere 7
2. Sori considerably hypertrophied. On *Zonotriche* ..... *M. zonotriches*
– Sori not or only little hypertrophied 3
3. Sterile cells up to 32 µm long, thick-walled (up to 5 µm). On *Eriachne* ..... *M. eriachnes*
– Sterile cells generally less than 18 µm long, thin-walled (0.5–1 µm) 4
4. Sterile cells 5–9.5 µm long. On *Eragrostiella* ..... *M. eragrostiellae*
– Sterile cells larger 5

5. Sterile cells 8–10(–14) µm long. On *Tripogon*.....*M. tripogonis*
– Sterile cells larger.....6
6. Sterile cells 11–17 µm long. Spores 7–10.5(–11) µm long, finely and densely punctate-verruculose. On *Panicum* and *Setaria*.....*M. sharmae*
– Sterile cells 10–28 µm long. Spores 9–12 µm long, densely, evidently echinulate. On *Setaria*.....*M. tanakae*
7. Sori in the hypertrophied flowers. On *Loudetia*.....*M. loudetiae*
– Sori in the stems.....8
8. Spores 4–6.5 µm long, verrucose. On *Vetiveria*.....*M. effusus*
– Spores larger.....9
9. Spores 7–9 µm long, wall unevenly thick, 0.5–1.5 µm. On *Tristachya*.....*M. tristachyae*
– Spores 8–12 µm long, wall evenly thickened.....10
10. Spores echinulate. Sterile cells 5–15 µm long, wall c. 0.5 µm thick. On *Chrysopogon* and *Capillipedium*.....*M. chrysopogonis*
– Spores finely punctate-verruculose. Sterile cells 12–35 µm long, wall 2.5–3 µm thick. On *Trichopteryx*.....*M. trichopterygis*

SOROSPORIUM ANTARCTICUM IS A *UROCYSTIS*

Spegazzini (1887) described *Sorosporium antarcticum* Speg. from *Azorella glebaria* A. Gray (Umbelliferae), collected by him in south Argentina. Because the sterile cells around the spores are dark, these were mistaken for spores and, consequently, the fungus was placed by Spegazzini into *Sorosporium*, a genus characterised by spore balls composed of spores only. However, the study of the type collection revealed the presence of sterile cells in the spore balls, typical for *Urocystis*.

Urocystis antarctica (Spegazzini) K. Vánky, **comb. nov.**

Basionym: *Sorosporium antarcticum* Spegazzini, Bol. Acad. Nac. Ci. 11:179, 1887. — Type on *Azorella glebaria* A. Gray, Argentina, Staten Is., cliffs near Port Vancouver, III.1882, C. Spegazzini (LPS 3668!).

Sori as pustules on the leaves and also in the inflorescence, filled with a dark brown, first agglutinated later disintegrating mass of spore balls. Spore balls globoid, ellipsoidal or irregular, 20–30 x 20–40 µm, composed of 1–5(–6) spores, incompletely, rarely completely invested by sterile cells, or sterile cells are lacking. Spores globose, broadly ellipsoidal, elongated or irregular with flattened contact sides, 13–17 x 15–21 µm, yellowish-brown, with finely granular content; wall ca. 1 µm thick, smooth. Sterile cells mostly collapsed, 10–19 µm long, reddish-brown, darker than the spores, smooth.

On Umbelliferae: *Azorella caespitosa* Cav. (*Bolax gummifera* Sprengel, *Azorella glebaria* A. Gray), S. America (Argentina).

The fragmentary type material seen did not permit a more accurate description of the sori.

EXCLUDED SPECIES

USTILAGO SENECIONIS IS A MYXOMYCETE

F. Neger collected a curious fungus on the leaves of *Senecio glaber* Less. (Compositae), in Chile, which was published in Dietel, 1898:(148), as "*Ustilago(?) senecionis* Diet. & Neg.", with the following description: "Sori hypophylli, rotundati vel oblongi, 1–2 mm diam., cinnamomei, epidermide levata fissaque velati vel semitecti, pulveracei. Sporae globosae vel ellipticae, 9–12 x 7–10 µ, dilute roseae, leves." (Sori hypophyllous, round or oblong, 1–2 mm diam., cinnamoneous, powdery, veiled or partially covered with smooth and fissured epidermis. Spores globose to ellipsoidal, 9–12 x 7–10 µm, pale roseaceous, smooth). In addition, Dietel wrote that this is a curious fungus which only with expressed doubt can be attributed to the genus *Ustilago*, ... Furthermore, Dietel says that at the base of the sori there is a 50–60 µm thick, brown-reddish layer of hyphae. In some of the sectioned sori colourless, irregular hyphae can be seen which traverse the sori in a "horizontal" direction, etc.

I have not seen the type of *Ustilago senecionis* which apparently was collected only once and it is not known where it is deposited. However, from the description I have no doubt that this fungus is a myxomycete, as are, i.a., *Ustilago fussii* Niessl, *U. lupini* Camara, *U. petasitidis* Rostrup, or *Melanotaenium byzovae* Schwarzman. The "epidermis" in the original description of *U. senecionis* is certainly the peridium around the sporangia, and the "hyphae" which traverse the "sori" in a "horizontal" direction must be the capillitia of a myxomycete.

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THE NOMENCLATURE AND TAXONOMY OF LEUCOAGARICUS PINGUIPES AND L. MACRORHIZUS, WITH A DESCRIPTION OF A RECENT BRITISH COLLECTION OF L. PINGUIPES

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Abstract

The nomenclature and taxonomy of *Leucoagaricus pinguipes* (A. Pearson) Bon and *L. macrorhizus* Locquin ex E. Horak are discussed, and an account is given of a recent British collection of *L. pinguipes*.

Key words: *Leucoagaricus pinguipes, L. macrorhizus*, Britain.

Introduction

The receipt of a well documented gathering of a *Leucoagaricus* species belonging to the *L. pinguipes - L. macrorhizus* complex led to a detailed investigation of the nomenclature and taxonomy of this group of fungi. Following this study it is concluded that if a single taxon is recognized at specific level, or if a single taxon is recognized with infraspecific taxa, then the correct name for that taxon is *Leucoagaricus pinguipes* (A. Pearson) Bon.

The taxonomic situation in regard to these taxa is more complicated since the macroscopic features exhibited by both fungi are very similar overall, although there may be considerable variation within a single collection. In contrast the microscopic characters are remarkably uniform and do not permit separation of the taxa involved. It was, therefore, concluded that only a single species should be recognized, for which the correct name is *Leucoagaricus pinguipes* (A. Pearson) Bon; the more familiar epithet *Leucoagaricus macrorhizus* Locquin ex E. Horak is reduced to synonymy under *L. pinquipes*. A detailed description of a recent gathering of *L. pinguipes* is given, based on a well documented gathering accompanied by colour transparencies; this gathering was made in South East London, by Mrs Anne Andrews, during October 1995.

Nomenclature

Leucoagaricus pinguipes belongs to a complex of closely related taxa, of which the most widely discussed and reported is *L. macrorhizus*. However when attempting to name these taxa, problems of both nomenclature and taxonomy are encountered.

The first taxon, belonging to this complex of species, was described by Locquin in 1943 as *Leucocoprinus macrorhizus* Locq., who listed a number or French gatherings: Récolté en août-septembre à la Croix-Rousse (Rhône), leg. M. Queney; et

à Lentilly (Rhône) et plusieurs stations; par temps très sec dans les jardins ou les lieux dont la terre est souvent travaillée". None of these gatherings was cited as type. However, it is unfortunate that this epithet was not validly published, as the author omitted to give a latin diagnosis.

This unsatisfactory position was finally rectified when Horak validated the epithet, in his Synopsís generum Agaricalium, published in 1968, with the provision of the required latin diagnosis and the designation of a lectotype ie: Chaumontel, S. et O., France, 18 Sept. 1959. However, Horak validated the epithet as *Leucoagaricus macrohizus* Locq. ex E. Horak [i.e. not as *Leucocoprinus macrorhizus* as originally proposed by Locquin].

In the intervening period of over 20 years between the initial invalid publication of both taxon and epithet, and subsequent validation, mycologists had become familiar with the circumscription of the species and with the epithet, which by then was firmly entrenched in the literature.

Meanwhile Pearson in 1952 described *Lepiota pinguipes* A. Pearson from the sand dunes of Braunton Burrows, Devon, United Kingdom, September 1945. Clearly Pearson had discussed this fungus both with Josserand and Locquin, who noted that while it was closely related to *L. macrorhizus;* it differed from it in many unspecified aspects. However, while *L. pinguipes* was well known to both the original collector (F.R. Ellison Wright) and to A.A. Pearson, who noted that it had occurred every year between 1945 and 1952, often in abundance, it remained something of an enigma to British mycologists. Indeed it was not subsequently reported from the UK until now. The species was also neglected in the literature of continental Europe, until Alessio (1988) drew attention to it in a publication entitled "*Leucoagaricus macrorhizus* Locq. ex E. Horak var. *pinguipes* (Pearson) n. comb." which was accompanied by a colour plate. This disposition was accepted by Italian mycologists (Migliozzi & Clericuzio (1989), Candusso & Lanzoni (1990), Migliozzi & Coccia (1991)). However, in addition to highlighting the taxon, it also highlighted an error of nomenclature, as follows.

For the purpose of nomenclature the name *Leucoagaricus macrorhizus* dates from 1968 (the date of validation), whereas *Lepiota pinguipes* dates from 1952, and takes priority over the former, if the two taxa are considered to be synonyms. However, in the event of a taxonomic decision that one of the two taxa involved merits varietal, rather than specific status - then *L. macrorhizus* should have been reduced to varietal rank, subordinate to *L. pinguipes*, and not the reverse as proposed by Alessio (l.c.).

Another taxon which is sometimes referred to the *"L. macrorhizus"* complex is *Leucoagaricus pseudocinerascens* (Bon) Bon. This was originally published as *Leucoagaricus macrorhizus* var. *pseudocinerascens* Bon 1991. Here again, **if** one accepts that *L. macrorhizus* and *L. pinguipes* are synonyms (with *L. pinguipes* as the valid name for the taxon) then in the event of a taxonomic decision to recognize *L. pseudocinerascens* at varietal level subordinate to the taxon (Migliozzi & Coccia) 1991), it should be subordinate to *L. pinguipes* (not to *L. macrorhizus*). However, Bon (1993) has expressed the view that his *L. macrorhizus* var. *pseudocinerascens* merits recognition an an independent species due to the distinctive cuticular structure of the pileal surface.

Taxonomy

Turning to a consideration of the taxonomic problem in relation to the interpretation of *Leucocoprinus pinguipes* and *L. macrorhizus*, there is remarkable uninamity of view amongst European mycologists that these two 'taxa' are extremely closely related - if not conspecific (Arnolds, *et al.* 1995).

The Russian author S.P. Wasser (1979, in litt. 1997) is of the opinion that *L. macrorhizus* and *L. pinguipes* are independent species, and that there are macroscopic and microscopic characters upon which to base a separation of the two taxa. Macroscopically, he claims that *L. macrorhizus* can be distinguished by the robust stature of its basidiomes, with pileus 5-12 cm in diameter, and in which the subterranean part of the stipe, exceeds in length, that of the aerial portion, and finally by the pileal surface which, especially at the disc, is covered by "large, adpressed grey-brownish scales", which may be somewhat excoriate in this region.

According to Wasser these macroscopic features are not characteristic of *L. pinguipes*. This same author also believes that there are differences in microscopic characters. With regard to spore size, he found that in his material from the former USSR, the spores were up to 9(10) μm in length and 5.5 (6) μm in width, whereas in *L. pinguipes* they are smaller [but see observations on the variation in spore size of the British collection in which older basidiomes produce spores with a greater range of spore size covering both taxa].

The Russian author is also convinced that there are differences in the form of both the epicuticular elements and cheilocystidia in the two taxa. Other European mycologists take a different view from that of Wasser (l.c.), following Alessio's (1988) publication in which he reduced *L. pinguipes* to varietal rank under *L. macrorhizus* (which was nomenclaturally incorrect. See above). He was followed by other Italian mycologists [Migliozzi & Clericuzio, 1989; Candusso & Lanzoni, 1990; Migliozzi & Coccia, 1991]. They accepted that the *pinguipes-macrorhizus* complex comprised a single species with several subordinate taxa at varietal level. If this view is accepted the correct epithet for the species involved is *L. pinguipes* (not *L. macrorhizus* for nomenclatural reasons).

Before accepting this solution to what is undoubtedly a complex problem it is necessary to compare the macroscopic and microscopic features of the two species in some detail - with particular emphasis on the poorly known *L. pinguipes*.

According to the original description and coloured plate published by Pearson (1952) *L. pinguipes* shows the following characters: **Pileus** small to moderate in size, 1 - 5 cm diam., varying from globate to campanulate, with a gibbous or subumbonate centre; colour at first white, then grey or brownish grey, the surface covered with dense, silky fibrillose scales (the plate shows the pileus becoming uniformly lead grey to the margin, without very evident scales). **Lamellae** white, very crowded, attached to a well defined collarium. **Stipe** 4 - 6 cm high, 5 - 15 mm wide, silky fibrillose, white, cylindric above, strikingly enlarged and fusiform-ventricose below, terminating in a short

acuminate base, narrowly fistulose. **Annulus** superior, mobile, white, at first involute and smooth, then spreading with shaggy edge. **Flesh** white, becoming grey or with a slight pink flush in the stipe. **Spore print** white. **Spores** 6.0 - 8.0 x 4.0 - 4.5 μm, ellipsoid, rounded at both ends with a short lateral apiculus, with or without guttule, dextrinoid, lacking a germ pore. **Cheilocystidia** 30 - 50 x 12 - 16 μm, large, cylindric or clavate and thin walled.

Alessio's (1988) account of this taxon is in broad agreement with Pearson's (1952) circumscription of *L. pinguipes,* differing only in the following minor characteristics: **Pileus** slightly larger (1 - 5 cm diam. fide Pearson versus (4) 5 - 6 (9) cm diam. fide Alessio), and with the surface disrupting, at least in some basidiomes, into fine concentrically disposed scales, producing a speckled effect, which is often less conspicuous toward the margin. The overall colour of the pileus is greyish brown with a darker centre, which may have an olive tint - such that when the plates of Pearson and Alessio are compared they look rather different. Nevertheless, Pearson (l.c.) indicates that the colour of the pileus of *L. pinguipes* can vary to brownish-grey. The stipe of Alessio's (l.c.) specimens is also slightly larger than in Pearson's material varying from 6 -8 cm high, and 1 - 2 cm broad, but although enlarged and clavate below, then narrowing slightly to the extreme base, it lacked the conspicuous acuminate form seen in Pearson's fungus. The microscopic data of Allesio's fungus are in almost complete accord with those of Pearson's fungus. The only discrepancy is that the spore measurements quoted by Alessio are slightly broader (6.0 - 8.0 x 4.5 - 5.5 (6.0) μm (Alessio) versus 6.6 - 8.0 x 4.0 - 4.5 μm (Pearson). Alessio's fungus occurred over a large area in the pineta di Torregrande (Orístano), Sardinia, Italy, in October and like the original material of *L. pinguipes*, it grew in sandy soil near the sea.

Candusso & Lanzoni (1990), having adopted the name *Leucoagaricus macrorhizus* var. *pinguipes* cited Alessio's material from Sardinia, together with a further Italian collection from San Rossore, Pisa. The macroscopic data provided by these two Italian authors matches that quoted by Alessio (which was originally supplied by Lanzoni). However, they provided additional microscopic data relevant to basidia, cheilocystidia and pileal surface: Basidia 25 - 35 x 8 - 10 μm clavate, 4-spored. Cheilocystidia 30 - 55 x 10 - 15 (18) μm, cylindric-clavate, clavate or ventricose. Pileal surface formed of hyphae with frequent septa, and comprising chains of cylindrical elements measuring 20 - 60 (80) x 8 - 16 μm, in which the terminal element was attenuated at the apex, - but always rounded; pigment membranal, smooth, together with a greyish vacuolar pigment.

Migliozzi & Clericuzio (1989) had previously given a detailed account of the collection from San Rossore, Pisa, which matches both the description of Alessio's material from Sardinia, and that of Pearson from Braunton Burrows. These authors (l.c.) noted that the pileal surface was covered with medium sized, silky-fibrillose, grey- brown squamules, on a dominantly pure grey background. Their microscopic data is also in close agreement i.e. spores (6.0-) 6.5 - 8.0 x 4.0 - 4.7 (5.2) μm ellipsoid, ovoid, dextrinoid, lacking a germ pore. Cheilocystidia 35 - 50 x 10 - 15 μm, mostly clavate, or strictly cylindric throughout their length. Pileal cuticle of articulated hyphae, not always exclusively interwoven, with the ultimate element slightly more elongated than the segments below, 25 - 60 (75) x (6) 8 - 12 μm.

Comparison of the original account and illustration of *L. pinguipes* with that of the lectotype of *L. macrorhizus* published by Horak (1968) and with subsequent accounts of both taxa show a fairly close concordance. However, there is the problem of the rooting stipe in the latter.

When Pearson (1952) described *L. pinguipes*, he noted that the stipe was "strikingly ventricose acuminate below" but in his latin diagnosis he used the phrase "ad basin accuminatus radicans". However, Horak (l.c.) described the stipe of *L. macrorhizus* as being "toward the base narrowed, often buried in soil, rooting" (transl.); his illustration shows virtually no demarcation between the aerial and subterranean portions of the stipe, but merely a short, slightly tapered base to the stem below ground. The illustration by Locquin (1943) again shows the subterranean portion to consist of a poorly defined, only slightly narrowed, blunt cylindric prolongation, equal to or exceeding the length of the aerial portion of the stem. In fact published illustrations of *L. pinguipes* and *L. macrorhizus* show variation in degree of development of a rooting base to the stipe, and there appears to be some intergradation with regard to this character as noted by Moreno *et al.* (1990). This view is strenghened by the observations of Zerova (1956) (nv), repeated by Wasser (1979, 1980) (nv) and cited by Migliozzi & Clericuzio (1989) that in arid regions the hypogeous rooting prolongation of the stipe constitutes an adaptation of the species to environmental conditions. If the foregoing observations are correct, then the presence or absence of, or the degree of development of a rooting base assumes less importance as a taxonomic character.

Collections referred to the *L. pinguipes* - *macrorhizus* complex show considerable variation in regard to colour, texture and degree of scaliness of the pileus. When young the pileus can vary from white to greyish with radially silky surface, which later disrupts into adpressed radially fibrillose scales, varying from rather indistinct to more prominent. With age the pileus becomes brownish-grey or greyish-brown - darker toward the centre, and disrupts into a multitude of radially fibrillose grey-brown scales or flecks on a whitish ground. These scales can vary from adpressed to slightly, or even conspicuously squarrose. Much of this variation can be seen in a single gathering, and cannot, therefore, form the basis for recognition of more than a single taxon.

Another character for consideration is the annulus, which Pearson (1952) described as mobile for his *L. pinguipes*, and this is confirmed by Alessio (1988) and Candusso & Lanzoni (1990). In contrast there is a strong concensus of opinion that in *L. macrorhizus* the annulus is nonmobile (eg. Horak, 1986 referring to the lectotype; Locquin, 1943; Bon, 1981; Candusso & Lanzoni, 1990; Babos, 1995; etc.). Nevertheless, there is, so far as I am aware, no suggestion in the literature that the moblie versus immobile annulus constitutes a character on which to base a separation of two 'taxa'.

Finally of the macroscopic characters there remains for comparison, only the overall size of the basidiomes of the 'taxa'. Migliozzi & Coccia (1991), discussing the "*L. macrorhizus*" complex, recognized three varieties viz. var. *macrorhizus*, var. *pinguipes*, and var. *pseudocinerascens*, and observed that "macroscopically the three varieties possess, between them, an enormous variability in the size of pileus; small in

var. *pinguipes* (2.5 - 5 (6) cm, medium in var. *pseudocinerascens* (4 - 7(8) cm, and large in var. *macrorhizus* (4 (5) - 12 (16) cm) [Transl]. They stressed the diameter of the pileus as a main character in their key for the recognition of these three taxa. Yet size of a basidiome and its constituent parts is subject to great variation in response to the environment, and in particular to the effects of habitat, soil conditions and climatic factors. As such, size seems too variable, to be of use as a major character on which to base the separation of two taxa. This view is strengthened by the fact that the British collection described below comprises basidiomes in which the pileus is 60 - 70 mm diam., i.e. somewhat intermediate in size between *L. pinguipes* and *L. macrorhizus*, but showing the typical colour and felty-fibrillose scaly surface of *L. pinguipes*.

A consideration of the microscopic characters, of the entities under discussion, shows them to be remarably similar - such that basidia, cheilocystidia and cuticular structure of the pileus are all too uniform to facilitate recognition of more than a single taxon. Migliozzi & Clericuzio (1989) also expressed the opinion that "Le dimensioni sporali, la struttura del rivestimento pileico, la forma e le dimensioni dei cheilocistidi sono praticamente identici".

However, a study of the spores does raise problems. Judged from the literature there would seem to be considerable difficulty in demonstrating the presence of a germ pore in the spores of *L. pinguipes* and *L. macrorhizus*. Pearson (1952) stated that there was "no germ pore visible" in the spores of his *L. pinguipes* - but it must be remembered that by modern standards, he was using inadequate microscopic equipment. Even so, quite recently Candusso & Lanzoni (1990) observed that in this same taxon , many spores have absolutely no visible germ pore, while others give the impression of the presence of a small pore, - but they were not absolutely certain on this latter point and advocated confirmation based on electron microscopy.

Various authors have also expressed difficulty in demonstrating the presence of a germ pore in the spores of *L. macrorhizus*. Horak (1986) when describing the spores of the lectotype indicated that the germ pore was small and easily overlooked. Bon (1981, 1987) indicated that the species had a narrow pore, which was not very visible; Migliozzi & Coccia (1991) noted that it is without a visible germ pore; Moreno *et al.* (1990) write: "Bon (1981, 1987) indicates and figures spores with a conspicuous germ-pore, but a study of material from his herbarium has revealed a small, hardly visible or absent germ pore, very similar to those of our collection; Babos (1995) observed that a germ pore was not evident in her Hungarian collections. Clearly no separation between *L. pinguipes* and *L. macrorhizus* can be made on this character.

Finally there is the question of spore size; and in particular of spore width; again there is overlap between the measurements cited for the two 'taxa'. Further, where very slight differences may be apparent, one does not always know if the measurements are strictly comparable - to be so the measurements should all be made on spores taken from spore prints, and mounted in the same mountants.

In Table 1 spore size, drawn from the literature, indicate just how slight are these supposed differences in width. Authors are unanimous in their account of the spores as being ellipsoid to ovoid.

Table 1. Spore data for *Leucoagaricus pinguipes* taken from the literature.

Author	Spore shape	Spore size
Pearson (1952) Holotype	Elliptical rounded at both ends, with short lateral apiculus	6.6-8.0 x 4.0-4.5 μm
Bon (1981)	obovoid or subobtuse	6.0-8.0 x 4.0-4.5 μm
Alessio (1988)	Droplet shaped	6.0-8.0 x 4.5-5.5 (6.0) μm
Migliozzi & Clericuzio (1989)	Ellipsoid oval	(6.0)6.5-8.0 x 4.0-4.7(5.2)μm
Migliozzi & Coccia (1991)		to 4.7(5.2) μm wide
Candusso & Lanzoni (1991)	Ellipsoid to slightly ovoid	(6.0)6.5-7.5(8.0) x (4.0)4.5 -5.2(5.8) μm

Table 2. Spore data for *Leucoagaricus macrorhizus* taken from the literature.

Author	Spore shape	Spore size
Locquin (1943)	Elliptic	6.5-8.0 x 4.0-5.5 μm
Horak (1968) Lectotype	broadly elliptic to oval, with lateral apiculus	7.0-8.0 x 5.0-5.5 μm
Wasser (1979)	Broadly elliptical to ovate, with lateral apiculus	6.0-9.0 x 4.5-5.5 μm
Bon (1981)	elliptic to subovoid	(6.5)7.5-9.0(11.0) x 5.0-5.5(6.0) μm
Groeger (1984)		(5.5)6.0-8.0(9.5) x 4.0 5.2 μm
Bon (1987)	Ellipsoid oval	9.0 x 5.5 μm
Candusso & Lanzoni (1990)	Elliptic to slightly ovoid	(6.0)6.5-8.0(8.5) x (4.0)4.5-5.5 μm
Migliozzi & Coccia	Ovoid in front view, amygdaliform in profile	(6.5)7.5-8.5 xx 5.0-5.5 μm
Babos (1995)	Ellipsoid ovoid	6.5-9.3 x 4.5-5.4 μm

From these tabulated data it can be seen that there is virtually complete

agreement by various authors in regard to their description of the spores of both taxa as ellipsoid-ovoid. There is also close agreement with regard to spore length i.e. 6.0 - 8.0 x 4.0 - 5.2 (6.0) μm for *L. pinguipes*; (6.0) 6.5 - 8.0 (9.0 - 11.0) x (4.0) - 4.5 - 5.5 (6.0) μm in *L. macrorhizus*.

Regarding spore width, one could argue that the spores of *L. macrorhizus* are slightly wider than those of *L. pinguipes*. However, before accepting any such view, I would like to see further evidence in its support. This would have to take the form of data obtained by a single author, based on examination of spores measured from spore prints from many collections, taken under comparable conditions, and examined in identical mountants, with the same optical equipment. Such requirements would be difficult to meet due to the rarity of the taxa. Without such data I regard any distinction based on extremely slight differences in spore width, cited in the literature (see Tables 1 and 2) as insufficient for recognition of two taxa.

Migliozzi & Coccia (1991) accepted a single species in the *pinguipes-macrorhizus* complex [for which they incorrectly adopted the name *macrorhizus*]. Within this species they recognized three varieties viz var. *pseudocinerascens* Bon; var. *macrorhizus* Locq. ex E. Horak; and var. *pinguipes* (A. Pearson) Alessio. They produced a key to these three taxa using a combination of the presence or absence of a rooting or subrooting base to the stipe, diameter of the pileus and spore width. Their key is produced below so that mycologists can put it to the test when naming their own collections, and see if the proposed characters are stable and correlated.

A Stipe non rooting, (pileus) of medium size, 4 - 7 (8) cm
L. macrorhizus var. *pseudocinerascens* Bon

A* Stipe subrooting to distinctly rooting ..... B

B Size (of pileus) medium large: 4 (5) 12 (16) cm, spore width up to 6 μm
L. macrorhizus var. *macrorhizus* Locquin ex E. Horak

B* Size small: 2.5 - 5 (6) cm, spore width to 4.7 (5.2) μm
L. macrorhizus var. *pinguipes* (A. Pearson) Alessio

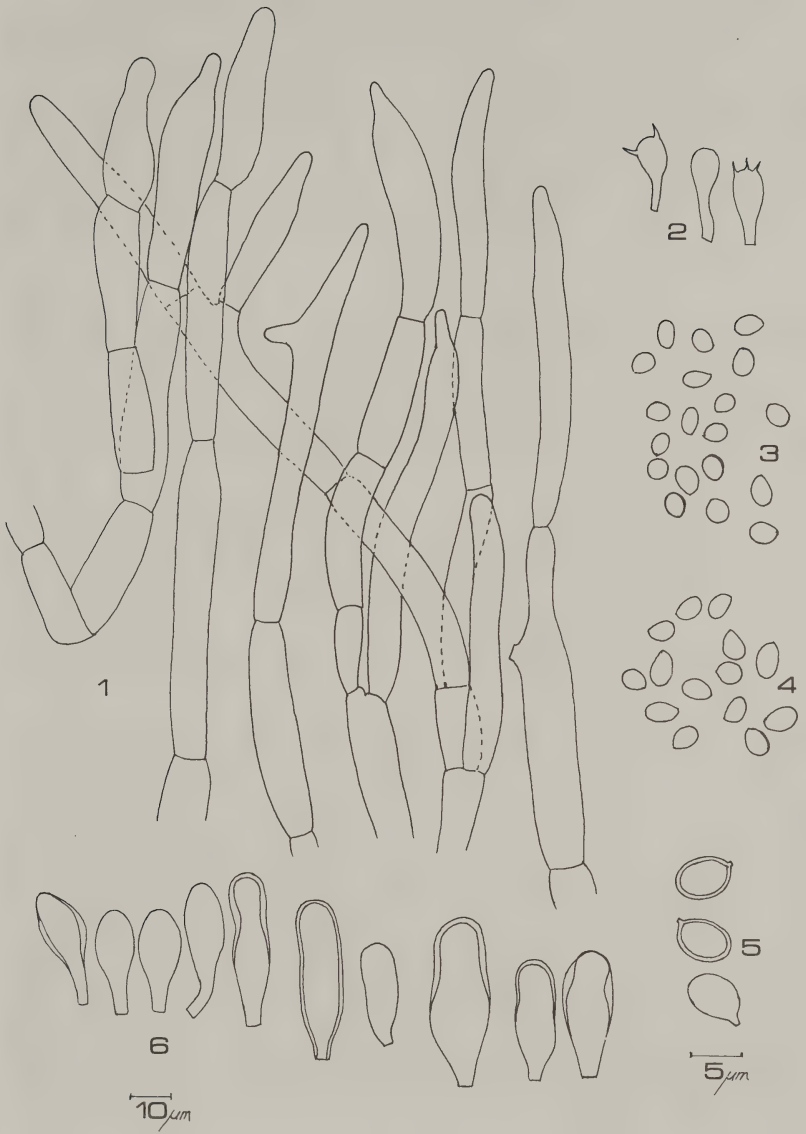
My own opinion is that the presence or absence of a rooting or subrooting base to the stipe and size of pileus are too variable for use as primary key characters, and spore width, as discussed above, appears too slight a difference to justify separation of two taxa. Hence in conclusion I consider that there is only one species in the *L. pinguipes-L. macrorhizus* complex for which the correct name is *L. pinguipes* (A. Pearson) Bon, and under which *L. macrorhizus* has to be reduced in synonymy.

Description of a recent British collection

Leucoagaricus pinguipes (A. Pearson) Bon, Documents Mycologiques 11 (43), 54, 1981.

Lepiota pinguipes A. Pearson, Trans. Brit. mycol. Soc. 35, 97, 1952.
Leucoagaricus var. *pinguipes* (A. Pearson) Alessio, Mic. Ital. 17, 8, 1988.

Pileus 60 - 70 mm diam., at first hemispherical with a flattened truncate disc, later expanding to shallowly convex with flattened disc; margin fringed, at first with



Figures 1-6. *Leucoagaricus pinguipes*. Fig. 1. Hyphal structure comprising tip of pileal scale. Fig. 2. Basidia. Fig. 3. Spores mounted in Melzer's reagent. Fig. 4. Spores from an older fruitbody mounted in Melzer's reagent. Fig. 5. Spores mounted in Melzer's reagent, bar = 5 µm. Fig. 6. Cheilocystidia.
Bar = 10 µm except where otherwise stated.

appendiculate remnants of the partial veil. Surface initially plushy tomentose sub lente, but soon disrupting into scales; at the disc these take the form of rather inconspicuous brownish-grey, felty pyramidal tufts without exposure of the underlying context, but away from the disc the surface has ruptured into similarly coloured ashy-grey, densely crowded, adpressed, radially arachnoid fibrils, or into fibrillose, V-shaped scales, which are more or less concentrically arranged, with the result that more dispersed and strongly squarrose, and more of the conspicuously radially fibrillose white flesh is exposed. Older specimens appear dark grey-brown at the centre, paling outward and may be almost devoid of scales. Pileus of fruitbodies from the roadside verge (see below), of similar size and shape, but appreciably paler, ranging from pale grey to almost whitish, with greyish-buff disc; the surface disrupting, away from the centre, into narrow, crowded concentric bands of more or less loosely adpressed, radially fibrillose scales. **Lamellae** of several lengths, free, fairly crowded, creamy white. **Stipe** to 80 mm high, 11 mm wide, cylindric above, becoming gradually enlarged to 16 mm toward the base, before tapering to a short subterranean rooting portion up to 30 x 10 mm, in some fruitbodies the stipe shows only slight enlargement in the lower portion; surface smooth, white, becoming hollow. **Annulus** apical, smooth, membraneous, with a thick cottony edge, white, underside with a blackish rim, soon torn from the stipe without trace, leaving appendiculate remnants on the pileal margin. **Flesh** white, but brownish in lower portion of stipe, and in the rooting base. **Structure of pileal scales** comprising long branching chains of hyaline segments, 7 - 13 (20) μm wide, with thin but distinct walls, lacking clamp-connections at the septa, and some with pale brownish sap. The terminal cells of these chains are 20 - 100 μm long, 7 - 13 μm wide, and vary from fusiform to somewhat lanceolate. **Pileal context** of very elongated, thin-walled, hyaline segments, which are mostly constricted at the septa, and 6 - 23 (50) μm wide. These hyphae, which are nonamyloid and non-dextrinoid, lack clamps. The context is also permeated by very long oleiferous hyphae, 6.6 - 10.0 μm diam., with oily refractive, straw-coloured contents. **Trama** comprising pseudoparenchymatic subhymenial layers, about 4 cells thick; the cells thin-walled, hyaline, angular, 5.0 - 6.6 μm diam., and a central strand of $\pm$ parallel, subregular to regular, thin-walled, hyaline hyphae, 5 - 10 μm wide, lacking clamps. **Cheilocystidia** 25.0 - 40.0 x 8.5 - 16.5 μm, mostly cylindric with a bluntly rounded apex, varying to pyriform, with hyaline, thin to slightly thickened walls. When thick walled, the thickening may be uniform, or there may be a conspicuous narrow band of internal thickening to about 2 μm in width, just below the apex, appearing as localized internal blister-like swellings. **Basidia** 18.0 - 23.0 x 7.0 -7.5 μm, thin-walled,hyaline, clavate, 4-spored, lacking a basal clamp. **Spores** from a mature, well dried basidiome measure 6.0 - 7.0 x 3.75 - 4.5 (5.0) μm in both Melzer's solution and ammonia, and are ellipsoid to broadly ellipsoid or ovate, with somewhat thickened walls, which become very tardily dextrinoid, germ-pore lacking. Spores from an older fruitbody tend to be more ellipsoid with a range of 6.2 - 7.0 (9.2) x 3.75 - 4.5 (-5.0).

Habitat: In three slightly different places in adjacent suburban gardens, and also on a grass verge of a main road, about 200 - 300 yards distant from the previous locality: South East London [TQ 404 749] during October 1995. About 20 fruitbodies were eaten by slugs or shrivelled prematurely. Dried material from these sites (preserved in the authors personel herbarium) was studied and formed the basis af the above account, with particular reference to a beautifully dried specimen collected on October 18th.

Specimens from the gardens and roadside verge appeared to be conspecific, but there were minor differences involving colour and texture of the pileal surface. Fruitbodies in prime condition from the gardens had a conspicuously scaly, dark ashy-grey pileus, darkest at the centre and conspicuously squarrose scaly toward the margin, whereas similar fructifications from the roadside verge, judged from colour transparencies, appeared very much paler grey to almost whitish, with a greyish buff disc, and with the surface disrupting into very numerous, narrow concentric bands of more or less adpressed fibrillose scales; other macroscopic features such as size, shape, and appearance of the lamellae and stipe were similar.

Discussion

The description of the above collection from South East London should be compared with that of the previous British gathering (Reid, 1989) as *Leucoagaricus macrorhizus* that was collected in Treborth Botanic Gardens, Bangor, Gwynned, 29 Sept. 1983 from a slightly heated greenhouse. However no data were available as to the appearance of the fresh specimens, so precluding any comparison with the London material.

Comparison of microscopic data show that both the London and Treborth material to have very similar structure of the pileal surface/scales. However, there are slight differences, involving the cheilocystidia; those from the Treborth material being narrower, to 40 x 7 - 10 μm, and predominantly lageniform, whereas those from the London material measured 25 - 40 x 8.5 -16.0 μm, and were predominantly bluntly cylindric with slightly thickened walls.

There are also slight differences in spore characters between the two British collections. In the Treborth material the spores were found to measure 7.75 - 8.5 x 5.0 (5.75) μm, to vary from broadly amygdaliform to ellipsoid, to have a dextrinoid reaction, and to possess a germ pore. The spores of the London material are perhaps, slightly more variable in shape, measuring 6.0 -7.0 x 3.75 -4.5 (5.0) μm , ranging from ellipsoid, broadly ellipsoid to ovoid, are tardily dextrinoid, and seemingly lack a germ-pore. Based on these observations the spores of the London gathering appear distinctly smaller than the Treborth gathering, quite apart from their lack of a germ-pore. However, spores produced by older fruitbodies of the London material, which appeared slightly more ellipsoid, showed a greater range in size i.e. 6.2 - 9.2 x 3.75 - 5.0 μm. Hence the apparent differences in spore dimensions of the British collections became less important and fall within the variation observed for *L. pinguipes* as discussed at the beginning of this paper. It is also interesting to note that Moreno *et al.* (1990) figure exactly similar variation in spore shape between different collections to that observed in the British gatherings.

As to the presence or absence of a germ pore in gatherings of *L. pinguipes* this has already been discussed above.

In summary it seems that the two British collections, discussed here, are conspecific, although showing slight variation in cystidial characters and those of the spores.

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A NEW SPECIES AND REVISED KEY TO THE GENUS RELICINA (ASCOMYCOTINA, PARMELIACEAE)

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ABSTRACT : *Relicina barringtonensis* Elix from Australia is described as new to science, and a revised worldwide key to the genus *Relicina* is presented.

Introduction

As a result of a continuing study of the lichen genus *Relicina* (Elix 1994, 1996; Elix & Johnston 1986, 1988, 1990), I am describing a further new species from Australia. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993; Elix *et al.* 1988), high performance liquid chromatography (Feige *et al.* 1993) and comparison with authentic samples.

Relicina barringtonensis Elix, sp. nov. Fig. 1

Species cum thallo ut in *Relicina subabstrusa* sed ab hac specie colore pallido subtus differt.

Type: Australia. New South Wales, Barrington Tops State Forest, Moppy Lookout, 40 km WNW of Gloucester, 31°53'S, 151°32'E, 1200 m, on canopy branch of *Nothofagus*, in *Nothofagus* dominated forest on gentle slope, *J. A. Elix 24825*, 26 April 1990; holo: CANB.

Thallus corticolous, foliose, adnate, irregularly spreading, to 3-5 cm wide. *Lobes* contiguous centrally to separate at the periphery, not or sparingly imbricate, linear-elongate, dichotomously to subdichotomously branched, 0.5-2.0 mm wide, elobulate; bulbate cilia dense, conspicuous, strongly inflated, to 1 mm long. *Upper surface* yellow-green, flat to weakly convex, smooth, emaculate, shiny at the apices, without isidia. *Medulla* white. *Lower surface* brown to dark brown; rhizines moderately dense, simple or occasionally dichotomously branched, coarse, brown to black. *Apothecia*

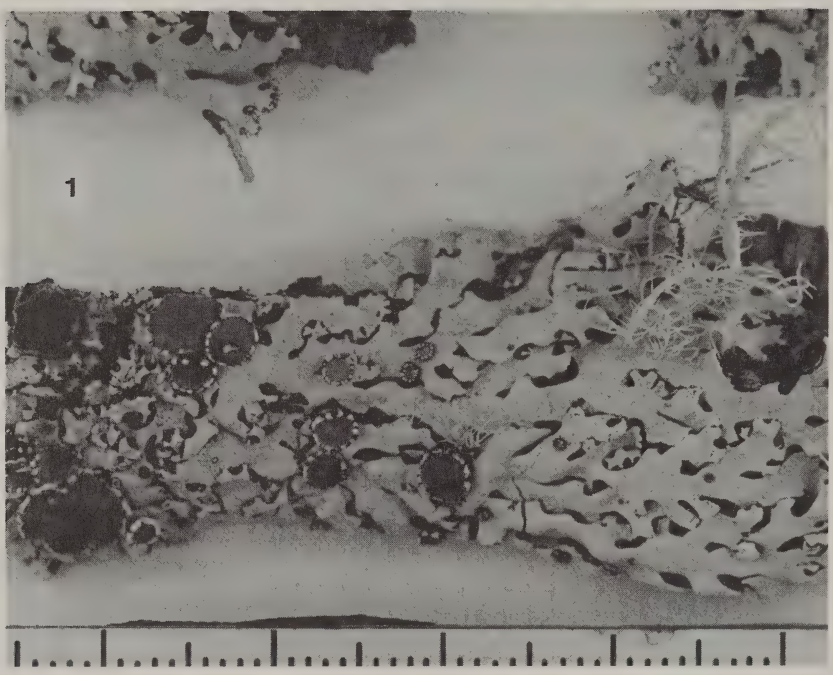


Figure 1. *R. barringtonensis* (part of holotype in CANB). Scale in mm.

common, adnate, 1-3 mm wide; disc more or less flat or shallowly concave, cinnamon-brown; thalline exciple markedly coronate to subcoronate, retrorsely rhizinate at base. Ascospores ellipsoidal, eight per ascus, 7-8 x 4-5 µm. *Pycnidia* common, flat to slightly emergent, punctiform, to 0.1 mm wide. Conidia bifusiform, 6-8 x 1 µm.

CHEMISTRY. Cortex K-; medulla K+ yellow-red, C-, P+ orange; containing usnic acid (major), ±atranorin (trace), norstictic acid (major), connorstictic acid (trace), hyposalazinic acid (trace).

Morphologically *R. barringtonensis* resembles the widespread species, *Relicina subabstrusa* (Gyeln.) Hale, since both species lack isidia and lobules, have coronate or subcoronate apothecia and contain norstictic acid as the major medullary substance. However, *R. barringtonensis* has a pale brown lower cortex and contains minor quantities of hyposalazinic and connorstictic acids, whereas *R. subabstrusa* has a jet black lower surface and lacks hyposalazinic acid. *R. barringtonensis* could also be confused with *R.*

filsonii Elix & J.Johnst., since these species are also morphologically similar and chemically identical. Although *R. filsonii* has a pale lower surface like *R. barringtonensis*, it differs in having ecoronate apothecia. At present *R. barringtonensis* is known only from several localities in Barrington Tops State Forest in New South Wales.

Specimens Examined

AUSTRALIA. New South Wales, type locality, on fallen twigs in *Nothofagus* dominated forest on gentle slope, *J. A. Elix 24827*, 26 April 1990 (CANB); Barrington Tops State Forest, Dilgry Circle Road, 40 km NW of Gloucester, 31°52'S, 151°31'E, 1260 m, on fallen canopy branch along edge of *Eucalyptus* and *Nothofagus* forest, *J. A. Elix 24942*, 26 April 1990 (CANB).

Revised key to the Species of *Relicina*

This key contains some corrections to the one published recently (Elix 1996) as well as incorporating the new species described above. An earlier version of this key was adapted for the Internet by Dr H. J. M. Sipman (Berlin). (http://www.bgbm.fu.berlin.de/bgbm/staff/wiss/Sipman+H/keys/Relicina.htm).

1. Thallus isidiate and/or lobulate 2
   Thallus not isidiate or lobulate 18

2(1). Isidia globose to cylindrical 3
   Isidia dorsiventral, becoming lobulate, or lobules only 12

3(2). Lower surface pale brown to dark brown 4
   Lower surface black, rarely brown-black at lobe margins 7

4(3). Rhizines simple or sparingly branched 5
   Rhizines with secondary rhizines which are densely branched and agglutinated 6

5(4). Isidia branched and coralloid; hypostictic and menegazziaic acid absent or present in traces only; southern & eastern Asia, Australia ..... ***R. sydneyensis*** (Gyeln.) Hale
   Isidia simple; hypostictic and menegazziaic acid present in significant amounts; Australia ..... ***R. ramboldii*** Elix & J.Johnst.

6(4). Cilia dense, to 2 mm long; containing protocetraric acid (major); south-east Asia, Australia ..... ***R. circumnodata*** (Nyl.) Hale
   Cilia sparse to moderate, to 0.3 mm long; containing succinprotocetraric acid (major), fumarprotocetraric acid (minor); Australia ..... ***R. conglutinata*** Elix & J.Johnst.

7(3). Lobes very narrow and tightly adnate, 0.3-1.0 mm wide; paleotropical ..... ***R. amphithrix*** Hale
Lobes broader, adnate, 1-3 mm wide 8

8(7). Medulla K+ intense yellow (or orange) or yellow turning red, containing stictic or norstictic acids 9
Medulla K-, or K+ pale yellow, containing 4-*O*-demethylbarbatic, echinocarpic or gyrophoric acids 10

9(8). Rhizines branched; medulla K+ intense yellow (or orange), containing stictic acid (major), norstictic acid (minor); Australia ..... ***R. subnigra*** Elix & J.Johnst.
Rhizines simple; medulla K+ yellow turning red, containing norstictic acid (major), stictic acid absent; pantropical ..... ***R. abstrusa*** (Vain.) Hale

10(8). Medulla P+ yellow or orange, containing echinocarpic acid; south-east Asia, Australia ..... ***R. planiuscula*** (Kurok.) Hale
Medulla, P-, containing 4-*O*-demethylbarbatic or gyrophoric acids 11

11(10). Lobes broad, 1.0-3.5 mm wide; medulla C+ pink or red, containing gyrophoric acid; New Guinea ..... ***R. vinasii*** Elix
Lobes narrow, 0.3-1.5 mm wide; medulla C-, containing 4-*O*-demethylbarbatic acid; Australia ..... ***R. demethylbarbatica*** Elix & J.Johnst.

12(2). Isidia present 13
Isidia absent 15

13(12). Lobes narrow, tightly adnate, 0.3-1.0 mm wide; paleotropical ..... ***R. amphithrix*** Hale
Lobes broader, adnate, 1-3.5 mm wide 14

14(13). Thallus coriaceous; apothecia ecoronate; south-east Asia, Australia ..... ***R. planiuscula*** (Kurok.) Hale
Thallus fragile; apothecia subcoronate; south-east Asia, Australia ..... ***R. schizospatha*** (Kurok.) Hale

15(12). Lobes narrow, tightly adnate, 0.3-1.5 mm wide 16
Lobes broader, adnate, 1-3.5 mm wide 17

16(15). Medulla P+ yellow or orange, containing echinocarpic acid; south-east Asia ..... ***R. palmata*** Elix
Medulla P-, containing relicinulinic acids A, B; south-east Asia, Australia ..... ***R. relicinula*** (Müll. Arg.) Hale

17(15). Medulla P+ yellow or orange; containing echinocarpic acid, ±gyrophoric acid (trace); New Guinea
.....***R. gemmulosa*** (Kurok.) Streimann
Medulla P-, C+ rose; containing gyrophoric acid (major), echinocarpic acid absent; south-east Asia
.....***R. luteoviridis*** (Kurok.) Hale

18(1). Lower surface pale brown to dark brown 19
Lower surface black, rarely brown-black at lobe margins 30

19(18). Rhizines densely branched and agglutinated, at least in part.....20
Rhizines simple or sparsely branched 25

20(19). Medulla K+ yellow then dark red; containing salazinic acid 21
Medulla K-, salazinic acid absent 22

21(20). Spores small, 3-4 x 2 µm; containing barbatic acid; Malaysia
.....***R. sabahensis*** Elix
Spores larger, 4-6 x 2-3 µm; barbatic acid absent; Indonesia
.....***R. acrobotrys*** (Kurok.) Hale

22(20). Medulla P-; containing barbatic acid; New Guinea
.....***R. agglutinata*** Elix & J.Johnst.
Medulla P+ red-orange; containing protocetraric, fumarprotocetraric or succinprotocetraric acids 23

23(22). Apothecia coronate; Philippines .....***R. precircumnodata*** Hale
Apothecia ecoronate or lacking 24

24(23). Spores small, *ca.* 3 x 2 µm; containing succinprotocetraric acid (major), fumarprotocetraric acid (minor); south-east Asia, Australia.....***R. ramosissima*** (Kurok.) Hale
Spores larger, 7-9 x 4-5µm; containing protocetraric acid (major); SE Asia, Australia, Solomon Islands.....***R. sublanea*** (Kurok.) Hale

25(19). Medulla K- or K+ pale yellow then dirty brown; containing protocetraric acid (major); Australia.....***R. dentata*** Elix
Medulla K+ intense yellow or yellow then red; protocetraric acid absent.....26

26(25). Medulla K+ yellow then red; containing norstictic acid (major)..... 27
Medulla K+ intense yellow; containing stictic acid (major).....28

27(26). Apothecia ecoronate; Australia.....***R. filsonii*** Elix & J.Johnst.
Apothecia coronate or subcoronate; Australia
.....***R. barringtonensis*** Elix

28(26). Apothecia subcoronate; lobes tightly adnate; Australia ..... ***R. subcoronata*** Elix & J.Johnst.
Apothecia ecoronate; lobes adnate 29

29(28). Lobes narrow, 0.5-1.5 mm wide; containing menegazziaic acid (major or submajor); Australia ..... ***R. clarkensis*** Elix & J.Johnst.
Lobes broad, 1-3 mm wide; menegazziaic acid absent or present in traces only; Australia ..... ***R. limbata*** (Laurer) Hale

30(18). Apothecia present, coronate or subcoronate 31
Apothecia ecoronate or absent 42

31(30). Medulla K+ yellow then red; containing norstictic acid; pantropical ..... ***R. subabstrusa*** (Gyeln.) Hale
Medulla K- or K+ yellow; norstictic acid absent 32

32(31) Lobes narrow, 0.3-1.5 mm wide; tightly adnate; gyrophoric acid absent or present in traces only 33
Lobes broad, 1-3 mm wide; adnate; containing gyrophoric acid (major); New Guinea, Solomon Islands ..... ***R. retrospinosa*** (Kurok. & Kashiw.) Streimann

33(32). Medulla P- 34
Medulla P+ yellow, orange or red 38

34(33). Diffractaic acid present; neotropical ..... ***R. incongrua*** Hale
Diffractaic acid absent 35

35(34). Hirtifructic acid present; New Guinea, Fiji ..... ***R. fijiensis*** Elix & J.Johnst.
Hirtifructic acid absent 36

36(35). Butlerins A, B, C and D present; Australia ..... ***R. kurandensis*** Elix
Butlerins A, B, C and D absent 37

37(36). Caperatic acid present; Malaysia ..... ***R. subconnivens*** Hale
Relicinulinic acids A, B present; south-east Asia, Australia ..... ***R. relicinula*** (Müll. Arg.) Hale

38(32). Spores 16-32 per ascus; containing malonprotocetraric acid (major); neotropical ..... ***R. relicinella*** (Nyl.) Hale
Spores 8 per ascus; malonprotocetraric acid absent 39

39(38). Medulla P+ brick red; succinprotocetraric acid present, echinocarpic acid absent; Florida, Carribean ..... ***R. eximbricata*** (Gyeln.) Hale
Medulla P+ pale yellow or yellow-orange; echinocarpic acid present; succinprotocetraric acid absent 40

40(39). Apothecia stipitate; medulla P+ pale yellow; containing diffractaic acid (major), echinocarpic acid (minor/trace); Guyana ..... ***R. stipitata*** Elix
Apothecia sessile; medulla P+ yellow-orange; containing echinocarpic acid (major), diffractaic acid absent 41

41(40). Lobes separate, axils broad; lacking hirtifructic acid; south-east Asia, Pacific, Australia..... ***R. samoensis*** (Zahlbr.) Hale
Lobes contiguous, axils acute; containing hirtifructic acid; New Guinea, Australia..... ***R. terricrocodila*** Elix & J.Johnst.

42(30). Medulla P- 43
Medulla P+ yellow, orange or red 44

43(42). Medulla UV+ blue-white; containing alectoronic acid; south-east Asia..... ***R. fluorescens*** (Hale) Hale
Medulla UV-; containing protolichesterinic acid, butlerins A, B, C; south-east Asia, Australia..... ***R. connivens*** (Kurok.) Hale

44(42). Medulla K+ yellow then dark red; containing salazinic acid.....45
Medulla K- or K+ pale yellow-brown; salazinic acid absent.....46

45(44). Thallus saxicolous; cilia 1-2 mm long, weakly inflated; lacking echinocarpic acid; Brazil..... ***R. xanthoparmeliformis*** Elix & Nash
Thallus corticolous; cilia 0.1-0.5 mm long, conspicuously inflated; containing echinocarpic acid; Japan ..... ***R. segregata*** Elix

46(44). Medulla P+ brick red; containing fumarprotocetraric acid.....47
Medulla P+ yellow or orange; containing echinocarpic acid..... 48

47(46). Rhizines squarrosely branched; succinprotocetraric acid absent; south-east Asia..... ***R. malesiana*** (Hale) Hale
Rhizines simple or sparingly furcate branched; succinprotocetraric acid present; Burma, Thailand ..... ***R. sublimbata*** (Nyl.) Hale

48(46). Medulla C+ rose or red; gyrophoric and hirtifructic acids present; New Guinea..... ***R. hirtifructa*** (Kurok.) Streimann
Medulla C-; gyrophoric and hirtifructic acids absent 49

49(48). Lobes narrow, 0.5-2 mm wide; upper cortex not columnar.....50
Lobes broad, 1.5-3 mm wide; upper cortex columnar; south-east Asia ..... ***R. columnaria*** Elix & J.Johnst.

50(49). Lobes 0.5-1 mm wide; lobes linear-elongate; New Guinea ..... ***R. sipmanii*** Elix
Lobes 1-2 mm wide; lobes sublinear; Japan ..... ***R. echinocarpa*** (Kurok.) Hale

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I wish to thank Dr Harrie Sipman (Berlin) and Dr André Aptroot (Baarn) for detecting errors in my published key to *Relicina*, and to Harrie for the very helpful corrections that he suggested. I also wish to thank Mr Stuart Hay and Mr Neal McCracken of the Photographic Unit, ANU, for preparing the photograph and Mr. D. Verdon for checking the Latin description.

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MYCOTAXON

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TAXONOMY OF ROYOPORUS PSEUDOBETULINUS COMB. NOV.

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SUMMARY

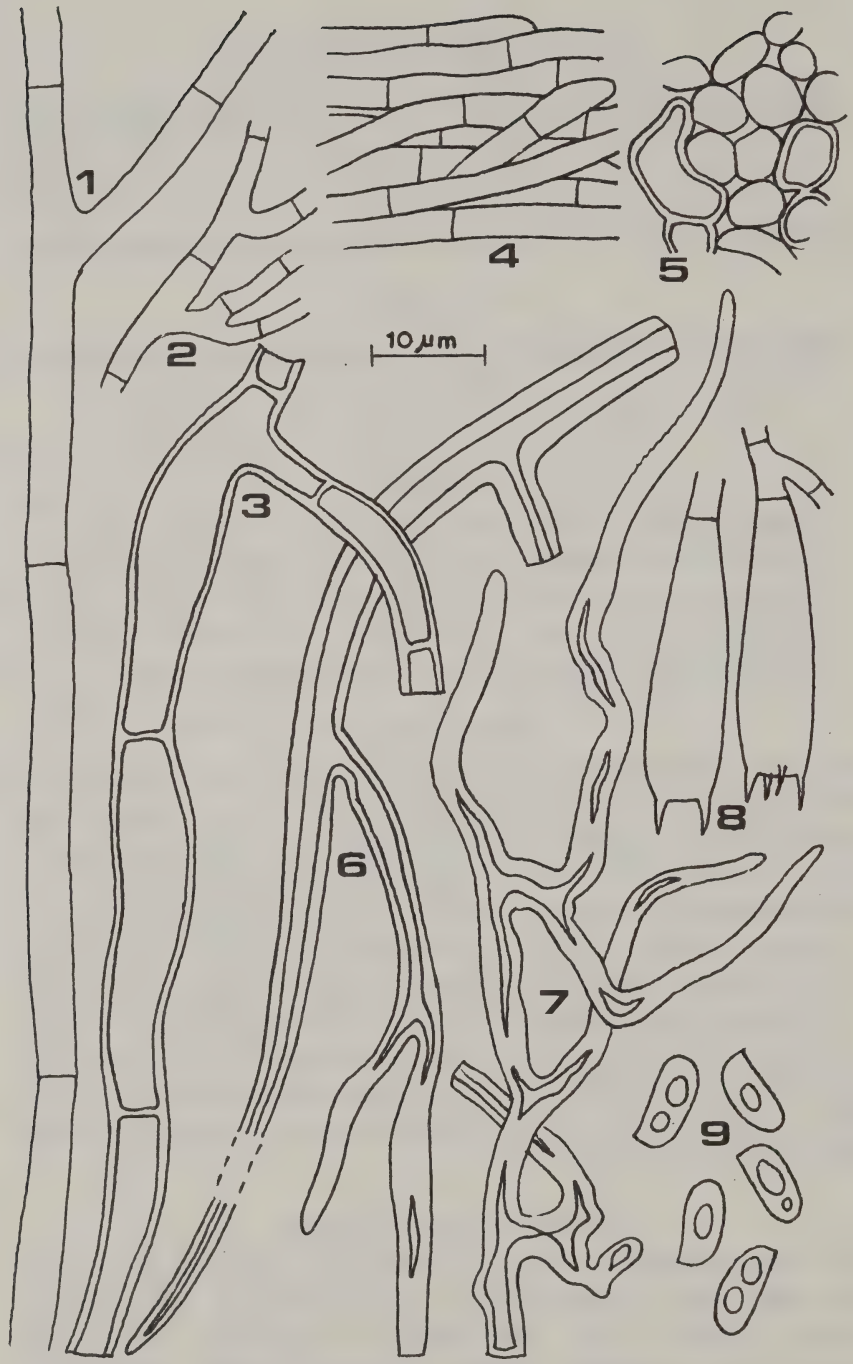
Morphological and anatomical characters of *Polyporus pseudobetulinus* (Murashk. ex Pilat) Thorn, Kotiranta et Niemela have been studied in detail and in the light of these findings the taxonomy of the fungus is discussed. The new combination *Royoporus pseudobetulinus* (Murashk. ex Pilat) De is proposed.

INTRODUCTION

Polyporus pseudobetulinus (Murashk. ex Pilat) Thorn, Kotiranta et Niemela occurs in Austria, Canada, Finland, Sweden (Niemela and Kotiranta 1991, Ryvarden 1978, Thorn *et al.* 1990), Japan and Russia (Nunez and Ryvarden, 1995). In Japan it has been found to grow on *Salix* (Nunez and Ryvarden, 1995) but in other countries it grows only on different species of *Populus* like *Populus tremula* L., *Populus nigra* L. and *Populus balsamifera* L. causing white rot (Thorn *et al.* 1990). The present paper reports the results of detailed studies on the morphological and anatomical characters of *Polyporus pseudobetulinus*. The taxonomy of the species is also discussed in the light of these findings and a new combination of the species in the genus *Royoporus* De is proposed.

MATERIALS AND METHODS

As *P. pseudobetulinus* is not reported to occur in India, sporophores of this fungus were procured from Botanical Museum, University of Helsinki, Finland (TN), and National Mycological Herbarium, Biosystematic Research Institute, Canada (DAOM). Microscopic


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10 µm
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character of the basidiocarps were studied from freehand sections mounted in 10% KOH and stained with 1% cotton blue.

DESCRIPTION OF BASIDIOCARPS

Royoporus pseudobetulinus (Murashk. ex Pilat) De, comb. nov.
Basionym : *Ungulina pseudobetulina* Murashk. ex Pilat, Bull. Soc. Mycol. Fr. 48 : 23, 1932.
= *Piptoporus pseudobetulinus* (Murashk. ex Pilat) Pilat, Atlas des champignons de l'Europe 3 : 123, 1937.
= *Polyporus pseudobetulinus* (Murashk. ex Pilat) Thorn, Kotiranta et Niemela, Mycologia 82(5) : 582, 1990.

Basidiocarp annual, pileate, solitary or imbricate in pairs, attached to the substratum by a narrow base or with a short stipe, pileus at first ungulate, then convex, applanate, semicircular or dimidiate, 4-17 x 5-24 x 1.4-4.5 cm., pulpy to elastic when fresh, coriaceous when dry, upper surface glabrous, azonate with a smooth, thin, peelable, glossy cuticle, cream, pale straw yellow to light brownish, often with some indistinct radial lines and with fine brownish to greyish orange fibrils, becoming areolate. Margin acute to obtuse and incurved. Context white to cream, homogeneous, up to 3 cm thick, fleshy, tough and corky on drying. Hymenial surface white when young, yellowish to orange with age and drying, pores angular, often radially aligned, 1-3 per mm, dissepiments thin, pore tubes up to 10 mm long, white to light yellowish orange.

Hyphal system dimitic. Generative hyphae simple septate, hyaline, usually thin-walled, 2.5-6.0 μm wide, occasionally branched (Fig. 1), in subhymenium very narrow, 1.5-2.5 μm wide and much branched (Fig. 2), in context some slightly thick-walled, infrequently branched and a little inflated, up to 14 μm wide (Fig. 3), on the pileus surface occur

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Figs. 1-9. Microscopic structures of *Royoporus pseudobetulinus* (Murashk. ex Pilat) De. 1. Occasionally branched generative hypha. 2. Narrow, much branched generative hypha. 3. Inflated generative hypha. 4. Closely interlaced, short-celled generative hyphae forming skin-like structure. 5. Cuticular cells. 6. Dendritic binding hypha. 7. Much branched binding hypha. 8. Basidia. 9. Basidiospores.

some closely interlaced, thin-walled, short-celled, up to 6 μm wide hyphae forming skin-like structure (Fig. 4) and some thin- to slightly thick-walled pale brown mass of cuticular cells (Fig. 5). Binding hyphae hyaline, dendritic, thick-walled, in the context 3-14 μm wide showing wide lumina and usually tapering to 1-2 μm wide whip-like tips (Fig. 6), in trama much branched, frequently subsolid, 1.5-4.5 μm wide (Fig. 7). Basidia hyaline, thin-walled, clavate, with 2 and 4 sterigmata, 18-40 x 5-7 μm, simple septate at the base (Fig. 8). Basidiospores hyaline, thin-walled, smooth, cylindrical to slightly fusiform, apiculate, non-amyloid, 7-10 x 2.5-3.5 μm, some with one or more guttulae (Fig. 9). Hyphal pegs infrequent.

SPECIMENS EXAMINED : Tervola, Pisavaara Strict Nat. Reserve, Finland, 29.7.1979, Tuomo Niemela and Heikki Kotiranta, TN 1524 and TN 1573. Grey county, Letterbreen, Ontario, Canada, 10.6.1987, R.G. Thorn and L.M. Banks, DAOM 198666. Ottawa-Carleton regional municipality, Hwy. 417 at McGee Sideroad, Ontario, Canada, 19.6.1988, R.G. Thorn, DAOM 198664.

DISCUSSION

The aforesaid description indicates that *P. pseudobetulinus* has a dimitic hyphal system with generative hyphae and binding hyphae and thus agrees with the views held by Nunez and Ryvarden (1995) and Thorn *et al.* (1990). The species lacks clamp connections. I saw only simple septa on the generative hyphae of *R. pseudobetulinus* and I did not find any clamp at the base of any basidium, i.e., the basidia were simple septate at base. Domanski *et al.* (1967) and Thorn *et al.* (1990) did not observe any clamps in this species and there are no clamps in cultures (Thorn *et al.*1990, Stalpers 1978). Thus Nunez and Ryvarden's (1995) report of a clamp connection at the base of basidium may be an error.

This species has been described under *Piptoporus* Karst. (Pilat 1937, Domanski *et al.*1967) and *Polyporus* Adans. : Fr. (Nunez and Ryvarden 1995, Thorn *et al.* 1990).

Piptoporus betulinus (Bull. : Fr.) Karst., the type species of the genus *Piptoporus*, causes a brown rot (Gilbertson and Ryvarden 1987)

whereas *P. pseudobetulinus* causes white rot (Thorn *et al.* 1990). The evolutionary and systematic importance of white rot versus brown rot has been emphasized by Nobles (1971), David (1980), Gilbertson (1980, 1981) and Redhead and Ginns (1985), and is now generally accepted. Therefore, *P. pseudobetulinus* causing white rot can not be congeneric with *P.betulinus* which causes brown rot. Corner's (1984) suggestion that *P. pseudobetulinus* might belong in *Buglossoporus* Kotl. & Pouz. is to be rejected for the same reason.

Presence or absence of clamp connections on generative hyphae is an important character in circumscribing genera (Teixeira 1994 p. 32, De 1996, 1997). Therefore, inclusion of *P. pseudobetulinus* by Thorn *et al.* (1990) in *Polyporus*, a genus characterised by the presence of clamps in all species, can not be agreed upon.

My study revealed that *P. pseudobetulinus* exhibits a combination of characters not found in any other existing genus except *Royoporus* De. Both *Royoporus spathulatus* (Jungh.) De, the type species of the genus *Royoporus* (De 1996), and *P. pseudobetulinus* possess annual, dimidiate, solitary to imbricate, very shortly and laterally stipitate basidiocarps with poroid hymenial surface having angular, radially aligned pores; white context; a dimitic hyphal system with hyaline, simple septate generative hyphae and hyaline binding hyphae; hyaline, smooth, thin-walled cylindrical, non-amyloid basidiospores with one or more guttulae and cause white rot of angiospermic wood. So many features in common suggest a close relationship between *R. spathulatus* and *P. pseudobetulinus*.

But there are some differences between *R. spathulatus* and *P. pseudobetulinus*. *P. pseudobetulinus* possesses cream, pale straw yellow to light brownish, smooth, glossy, thin, peelable cuticle at the pileus surface but such cuticle is absent in *R. spathulatus*. Besides, basidiocarps of *P. pseudobetulinus* are relatively larger and thicker than those of *R. spathulatus*. But these exomorphological differences may be considered important only at the species level.

Therefore, it is concluded that *P. pseudobetulinus* and *R. spathulatus* are congeneric, and the transfer is proposed above.

ACKNOWLEDGEMENT

I am greatly indebted to Dr. J. Ginns, National Mycological Herbarium of Canada, for critically reviewing the manuscript. I am also indebted to the Curator, National Mycological Herbarium, Biosystematic Research Institute, Canada (DAOM) and to Dr. Tuomo Niemela. Botanical Museum, University of Helsinki, Finland (TN) for providing me with the specimens for study.

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POLYBULBOPHIALE PALMICOLA GEN. ET SP. NOV. (HYPHOMYCETES) FROM BRUNEI

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Abstract

Polybulbophiale palmicola gen. et sp. nov. (Hyphomycetes) occurring on a decaying petiole of *Licuala* sp., collected from a tropical rain forest in Brunei, is described and illustrated. It is unique in having discrete, swollen, flask-shaped, brown, percurrently proliferating, phialidic conidiogenous cells, being clustered around the base of macronematous, mononematous conidiophores. The conidiophores are provided with terminal, swollen, phialidic conidiogenous cells, producing fusoid, 3-septate, hyaline conidia. The genus is compared with *Chaetochalara*, *Dictyochaeta*, *Mahabalella*, and other similar hyphomycete genera.

Key words: mitosporic fungi, palm fungi, phialidic conidiogenesis, systematics

Introduction

During a survey of microfungi occurring on decaying palm material in a tropical rain forest at Kuala Belalong Field Studies Centre in Brunei Darussalam, we found an undescribed dematiaceous hyphomycete on a senescent petiole of *Licuala* sp. The hyphomycete is unique in having discrete, swollen, flask-shaped, brown, percurrently proliferating, phialidic conidiogenous cells, being clustered around the base of distinct conidiophores, and producing fusoid, 3-septate, hyaline conidia. Since this fungus cannot be appropriately placed in any of the known genera of Hyphomycetes (Carmichael et al., 1980; Ellis, 1971, 1976), we therefore propose a new genus to accommodate it.

Taxonomy

Polybulbophiale Goh & K. D. Hyde, gen. nov.

Etymology: *Polys* (Greek) = many, *bulbus* (Latin) = bulb, *phiala* (Latin) = shallow cup, bowl, referring to the unique morphology of the conidiogenous cells.

Ad fungos conidiales, Hyphomycetes, pertinens. Coloniae in substrato naturali effusae, pilosae, atrobrunneae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis laevibus, septatis, compositum. Stromata absentia vel tenuiter

evoluta. Setae nullae. Hyphopodia absentia. Conidiophora macronematosa, mononematosa, solitaria vel sparse fasciculata, erecta, recta, non ramosa, multiseptata, dematiacea, laevia, ad apicem cellulo conidiogeno singulatim praedita. Cellulae conidiogenae in conidiophoris incorporatae et discretae, terminales vel basi conidiophororum aggregatae, bulbosae, ampulliformes, collum breve praeditae, monoblasticae, determinatae, interdum regenerationis percurrentes. Conidia enteroblastico-phialidicae, solitaria, in masso gregaria, fusoidea, tenuitunicata, laevia, hyalina, euseptata, asetulata.

Species typica: *Polybulbophiale palmicola* Goh & K. D. Hyde

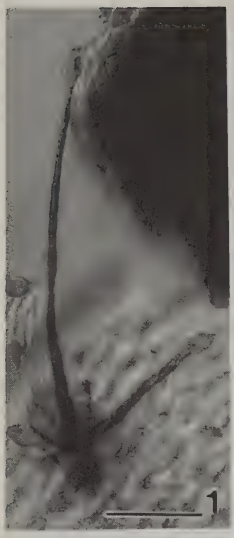
Conidial fungi, Hyphomycetes. *Colonies* on natural substratum effuse, hairy, dark brown. *Mycelium* partly superficial and partly immersed in the substratum, composed of smooth, septate hyphae. *Stromata* absent or poorly developed. *Setae* and *hyphopodia* absent. *Conidiophores* macronematous, mononematous, solitary or in loose fascicles, erect, straight, unbranched, multiseptate, dematiaceous, smooth, bearing a conidiogenous cell at the apex. *Conidiogenous cells* integrated or discrete, terminal and aggregated at the base of the conidiophores, bulbose, flask-shaped, with a distinct, short, unflared neck, monoblastic, determinate, sometimes regenerating percurrently. *Conidia* enteroblastic-phialidic, solitary, aggregated in a mucoid mass at the apex of the conidiogenous cells, fusoid, thin-walled, smooth, hyaline, euseptate, asetulate.

Polybulbophiale palmicola Goh & K. D. Hyde, sp. nov. (Figs. 1-16)

Etymology: *palmicola*, referring to the palm host where this species was found.

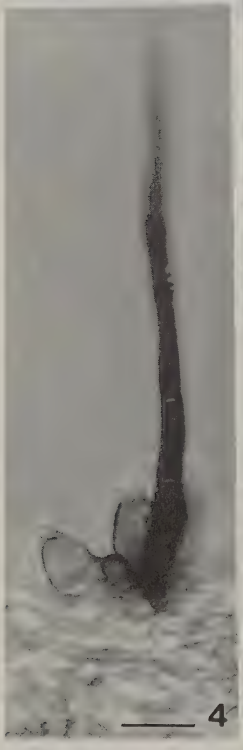
Coloniae in substrato naturali, pilosae, atrobrunneae. Mycelium partim superficiale et partim immersum, ex hyphis laevibus, septatis, subhyalinis vel pallide flavidobrunneis, 2-4 µm latis compositum. Stromata absentia vel ex cellulis inflatis paucicomposita. Conidiophora solitaria vel usque 5 in fasciculo divergentia, erecta, recta, non ramosa, plus minusve cylindrica vel apicem versus leniter attenuata, 40-130 µm longa, deorsum 4.5-5 µm lata, superne 2.5-4 µm lata, multiseptata, flavidobrunnea vel modice brunnea, apicem versus leniter pallidiora, crassitunicata, laevia, ad apicem cellula conidiogena singulatim praedita. Cellulae conidiogenae 8-15 x 6.5-8 µm, pallide flavidobrunneae, in conidiophoris incorporatae vel discretae, apice conidiophororum terminaliter oriundae et basi conidiophororum sparse vel dense aggregatae, bulbosae vel ampulliformes, collum et ostiola praeditae, determinatae, saepe regenerationis percurrentes. Conidia enteroblastico-phialidica, solitaria, in masso aggregata, fusoidea, utrinque acuta, leniter curvata vel raro sigmoidea, tenuitunicata, laevia, hyalina, indistincte (2-)3-septata, 22-45 x 3-4 µm.

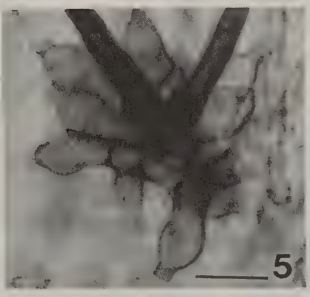
Figs. 1-7. *Polybulbophiale palmicola* (from holotype). Figs. 1, 2. Conidiophores with apical and basal conidiogenous cells. Fig. 3. A conidiophore illustrating septation and an apical, flask-shaped, conidiogenous cell bearing a developing conidium (arrowed, not in focus). Figs. 4, 5. Conidiogenous cells at the base of conidiophores. Figs. 6, 7. Groups of basal conidiogenous cells. Scale bars: 1 = 20 µm, 2-7 = 10 µm.


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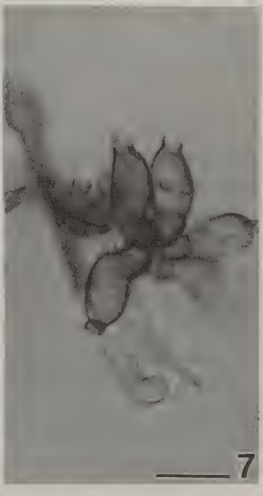

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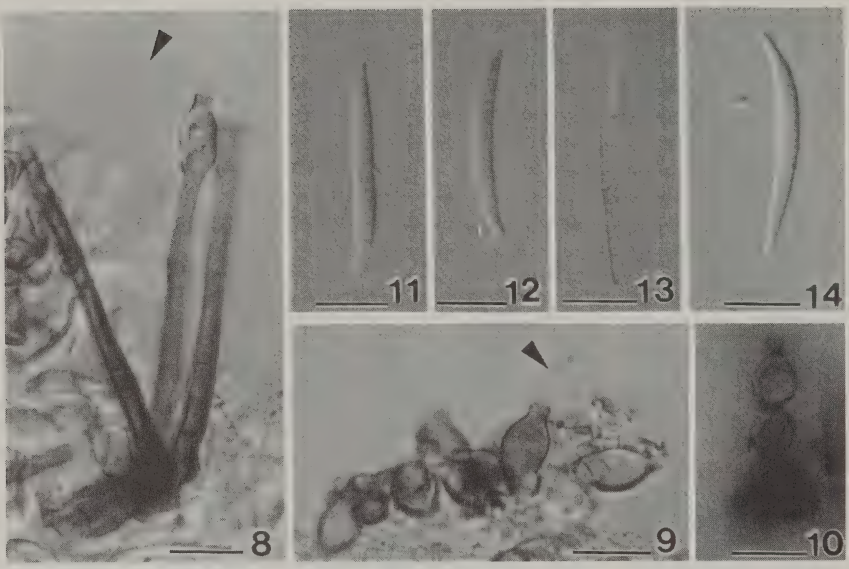

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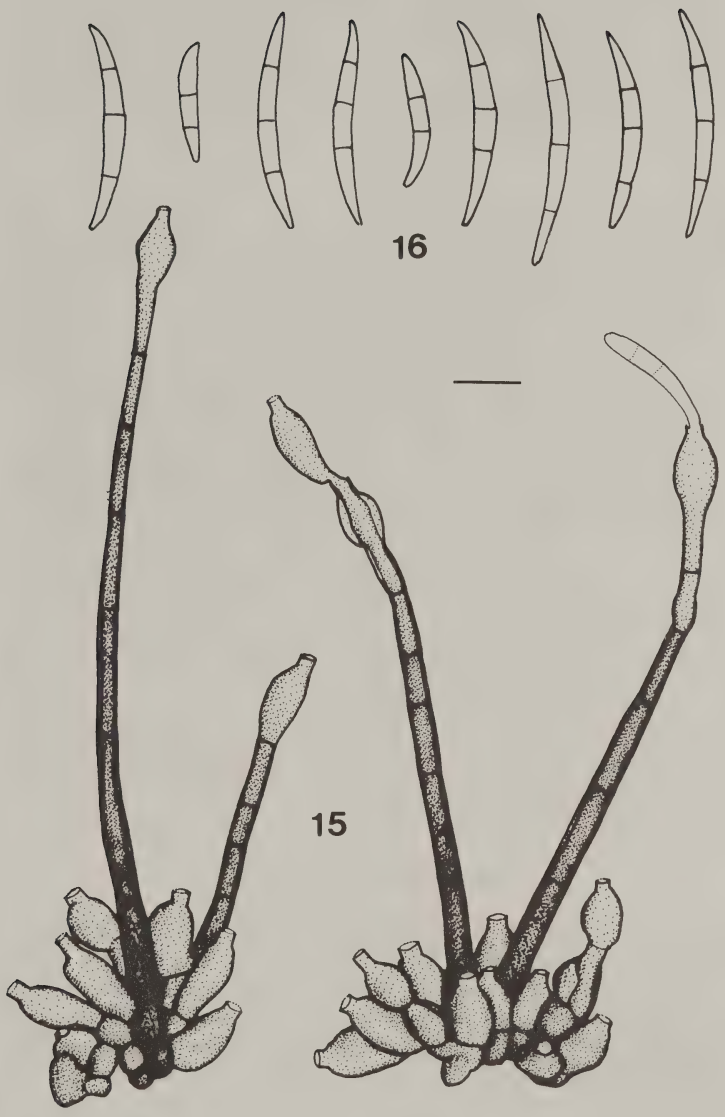

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Figs. 8-14. *Polybulbophiale palmicola* (from holotype). 8. Fascicle of conidiophores, one illustrating an apical conidiogenous cell bearing a developing conidium (arrowed). Fig. 9. Basal conidiogenous cells, one bearing a developing conidium . Fig. 10. Percurrent regeneration of conidiogenous cells. Figs. 11-14. Conidia. Scale bars: 8-14 = 10 µm.

HOLOTYPUS: BRUNEI DARUSSALAM, Temburong: Kuala Belalong Field Studies Centre, Ashton Trail, on a decaying petiole of *Licuala* sp. (Arecaceae), Aug. 1997, K.D. Hyde & T.K. Goh, L17 (HKU(M) 4717).

Colonies on natural substratum, hairy, dark brown. *Mycelium* partly superficial and partly immersed in the substratum, composed of smooth, septate, subhyaline to pale yellowish brown, 2-4 µm wide hyphae. *Stromata* absent or very rudimentary, composed of knots of swollen hyphal cells. *Conidiophores* solitary or up to 5 in a divergent fascicle, erect, straight, unbranched, more or less cylindrical or slightly tapered towards the apex, 40-130 µm long, 4.5-5 µm wide near the base, 2.5-4 µm wide near the apex, multiseptate, yellowish brown to medium brown, slightly paler towards the apex, thick-walled, smooth, terminating in an apical conidiogenous cell (Figs. 1-3, 8, 15). *Conidiogenous cells* 8-15 x 6.5-8 µm, pale yellowish brown, integrated or discrete, terminally situated at the apex of the conidiophores and also sparsely or densely aggregated at the base of the conidiophores, bulbose or flask-shaped, with a short (ca. 2 µm deep) distinct neck and a 2.5-3 µm wide ostiole, determinate, often regenerating percurrently (Figs. 4-7, 9, 10, 15). *Conidia* enteroblastic-phialidic, solitary, aggregated in a mucoid mass at the apex of the conidiogenous cells, fusoid, acute at both ends,



Figs. 15, 16. *Polybulbophiale palmicola* (from holotype). Diagrammatic representation. Fig. 15. Conidiophores and basal conidiogenous cells, with some percurrent regeneration. Fig. 16. Conidia. Scale bar = 10 µm.

slightly curved or rarely sigmoid, thin-walled, smooth, hyaline, indistinctly (2-)3-septate, 22-45 x 3-4 µm (Figs. 11-14, 16).

Teleomorph: Unknown.

Distribution: Known only from Brunei.

Discussion

Conidiogenous cells with "phialidic" conidiogenesis (*sensu* Minter et al., 1983) occur in several of hyphomycete genera (Carmichael et al., 1980). Amongst these "phialidic" hyphomycetes, however, only a few genera produce dematiaceous, bulbose or swollen ampulliform conidiogenous cells similar to those of *Polybulbophiale palmicola*. These include *Chaetochalara* B. Sutton & Piroz., *Chalara* (Corda) Rabenh., *Mahabalella* B. Sutton & S. D. Patil, *Monocillium* S. B. Saksena, *Sporendocladia* G. Arnaud ex Nag Raj & W. B. Kendr., and *Torulomyces* Delitsch (Carmichael et al., 1980; Ellis, 1971, 1976). *Polybulbophiale* is distinct from these genera in having bulbose, percurrently regenerating conidiogenous cells aggregated at the base of erect, unbranched conidiophores, and producing fusoid, hyaline, multiseptate, asetulate conidia. *Chaetochalara*, *Chalara*, and *Sporendocladia* differ from *Polybulbophiale* in their cylindrical, hyaline, catenate endoconidia which are extruded from the long neck of the conidiogenous cells. *Monocillium* and *Torulomyces* differ in their globose to ellipsoidal, catenate conidia. *Mahabalella* differs in its setulate, oblong conidia. Certain species of *Dictyochaeta* Speg., e.g. *D. gyrosetulae* Kuthub. & Nawawi, *D. sampahia* Kuthub. & Nawawi, and *D. subfuscospora* Kuthub. & Nawawi, produce erect setae which are sometimes fertile and bear "phialides" in addition to the fascicles of conidiophores at the base of the setae (Kuthubutheen & Nawawi, 1991). These characters approach those of *Polybulbophiale* with the discrete basal conidiogenous cells. These *Dictyochaeta* species, however, differ from *Polybulbophiale* primarily in the shape of their conidiogenous cells, being cylindrical, sometimes polyblastic, and with a distinctly flared, funnel-shaped collarettes.

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A CONIDIA-FORMING BASIDIOMYCETE IN THE PTERULACEAE

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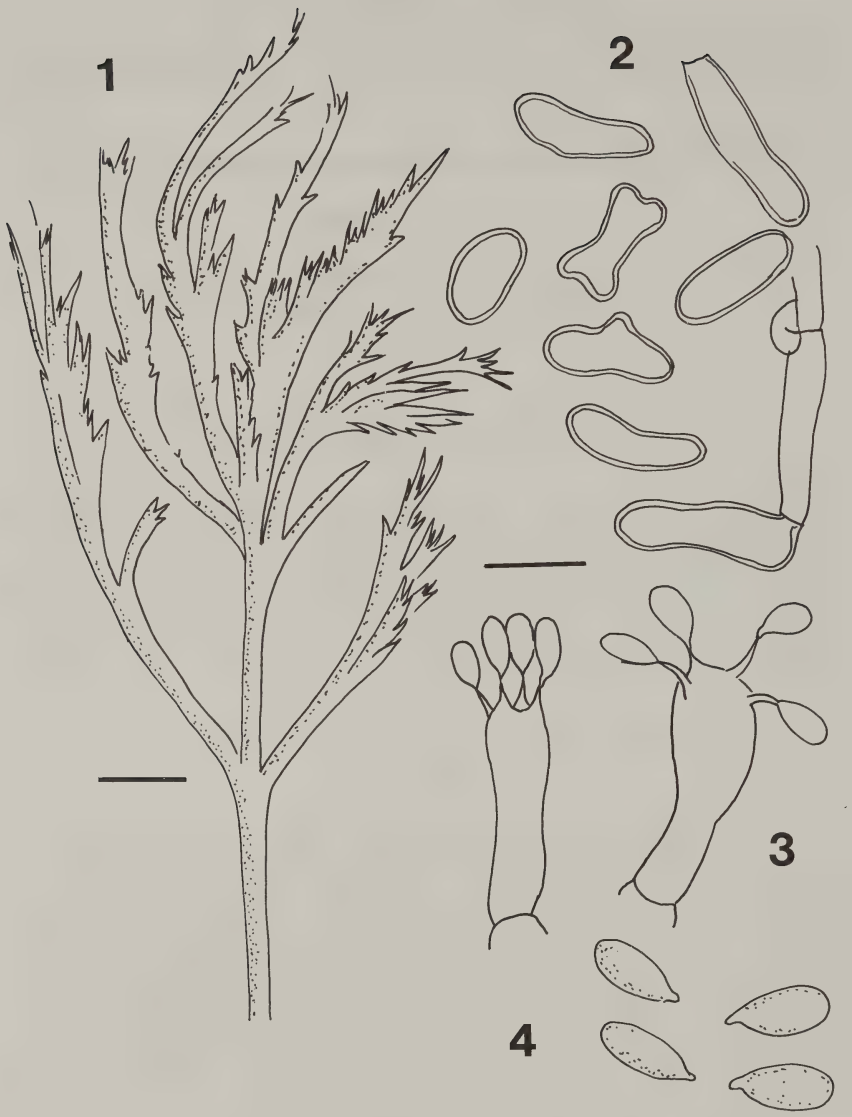
During an investigation on exotic weeds, a small, branched clavarioid fungus was collected in Montana grasslands. The clavarioid form and presence of a dimitic hyphal system place it in Pterulaceae (Aphyllophorales). Prolific conidia are a consistent feature of the mycelium in pure culture, and examination of the basidiocarps revealed similar conidia on the attenuated branch tips of some specimens. The taxon is designated here as *Pterula subulata* Fr. conidial form. Conidia formation, while not unknown in clavarioid fungi, is rare, and has not been reported for this genus.

Key words: Basidiomycetes, clavarioid, conidia, fungi, Pterulaceae

INTRODUCTION

A branched *Pterula* was collected during an investigation of exotic weeds in central Montana grasslands. The cespitose fungus forms fairy rings in grass, and is humicolous, but is occasionally observed on plant debris. It is of interest because of its association with reductions in stand density of leafy spurge (*Euphorbia esula*) as the ring expands. This has been observed over a seven year period, and research is underway to investigate causality. The small *Pterula* fruits primarily in the fall and is difficult to detect in the dense grass. Thallic-arthroconidia are a consistent feature of the mycelium in culture. Subsequent microscopic examination of the basidiocarps revealed the same type of conidia on the pilose, attenuated branch tips of some specimens. Hyphal strands, in some cases, possess both clamps and conidia. In addition, basidiocarps have 4-sterigmate holobasidia in the normal hymenial area below the branch tips.

The pliant but tough, branched, clavarioid fructifications with clamps and dimitic hyphal system place this fungus in the Pterulaceae (Corner 1970). This taxon was previously designated the Pteruloid series of the Clavariaceae (Corner 1950) and was later raised to family rank (Corner 1970). The skeletal hyphae produce tough rather than fragile flesh as in other coral fungi. The erect character and lack of gloeocystidia are features of the genus *Pterula,* a small group of primarily tropical clavarioid fungi. Corner's two revisions (1952; 1970) of the Monograph of Clavaria and Allied Genera



Figures 1-4. *Pterula subulata* conidial form. 1. Basidiocarp. 2. Conidia on branch tips. 3. Basidia. 4. Basidiospores. Left bar = 5 mm for Fig. 1; right bar = 10 μm for Figs. 2- 4.

(Corner 1950) delineate a few temperate, humicolous species including *Pterula subulata* Fr. which best fits specimens examined.

The multifid branching, wide spores (3-4.5 µm), and thick skeletal hyphae are characteristic of *P. subulata* Fr. sensu Corner 1952. There has, however, been taxonomic confusion in this group of species (Corner 1950, 1952, and 1970; Lloyd 1919) which needs to be clarified by further research. This taxon is presented here as *Pterula subulata* Fr. conidial form, so as not to confuse the issue with a new species epithet. Other conidia-forming clavarioid fungi are reviewed in the discussion section, as are the ecological implications of diverse reproductive strategies.

Pterula subulata Fr. conidial form Figs. 1-8.

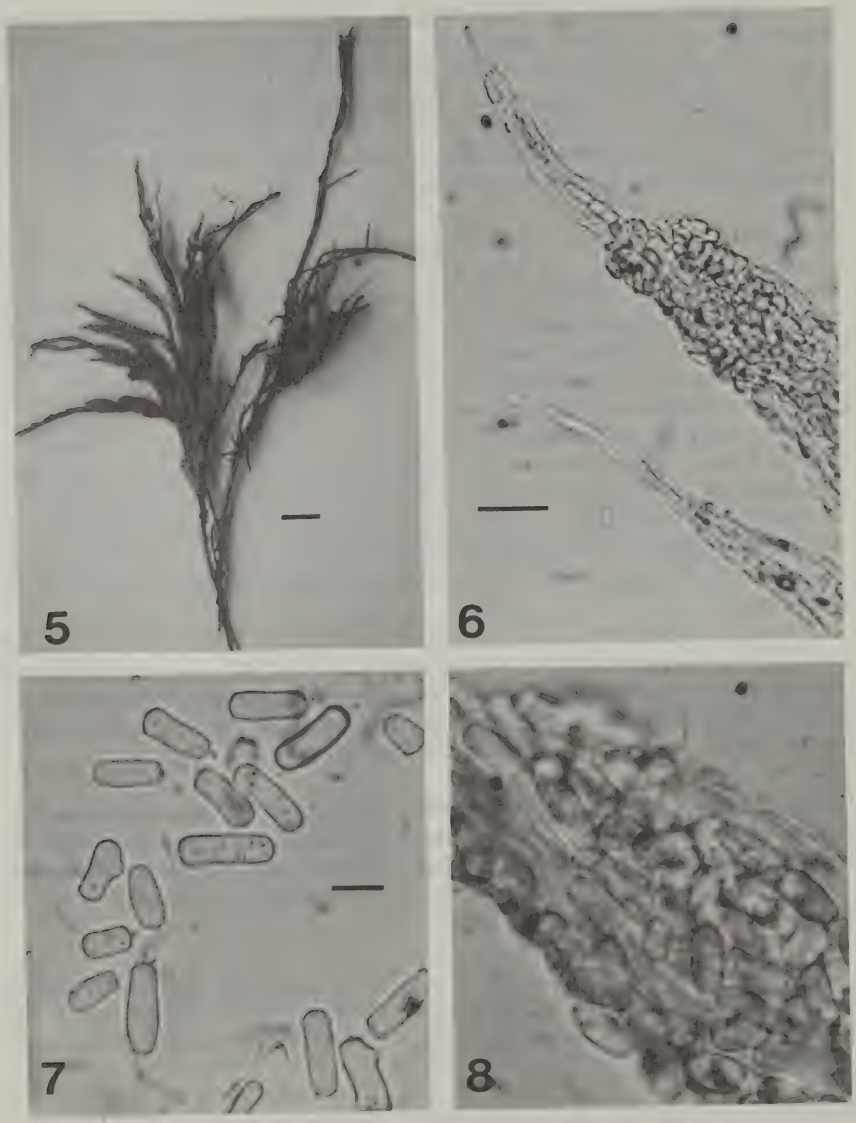
Fructifications (Figs. 1, 5) 3-7 cm tall, erect, clavarioid, branched, cespitose or individual, cream, buff, pale fawn, pale watery brown, gray-brown or brown with reddish hue; *stem* terete or somewhat flattened, 1-2 mm in diam, 1-2 cm in length; *branching* bushy, not extremely dense, first and second tiers multifid or dichotomous, diverging into finer branches; *main branches* 1 mm wide, terete or flat, anastomosis limited; *branch tips* spathulate, breaking up into many growing points, up to 3 mm in diameter, in some collections attenuated to white pilose tips which converge to form a mass of fluffy white mycelium at the apex of the fungus; short spikes (branch initials) common along main branches; *surface of fruiting body* smooth or with fine white hoary pubescent until handled; subsurface layer waxy; flesh rather tough, but pliant, drying gray-brown and shrinking to thin hairs; odor distinctive, not clearly defined, moldy-fishy, musty, or of chemicals.

Basidiospores (Fig. 4) 5.5-7(8) x (2.8) 3-4.5 µm, white, elliptical, long-teardrop shaped, with distinct apiculus, thin-walled, smooth, may appear finely granular; *holobasidia* (Fig. 3) 7.5-9 x 15-23 µm, clavate, with 4 long sterigmata which can be flaccid causing spores to droop; lacking cystidia, gloeocystida, and caulocystidia.

Hyphal system dimitic; generative hyphae, thin-walled, septate, with clamp connections; skeletal hyphae up to 3 - 7 µm in diameter, aseptate, not branched, with smooth walls up to 1 µm thick; *hyphal elements* which produce pubescence, as clamped generative hyphae, or as partially inflated and regularly constricted hymenial elements (McLaughlin et al. 1978, Fig. 21).

Conidia on fructifications (Fig. 2, 6-8) 4-5 x 9-15 µm, rectangular with rounded edges or irregular, with thickened cell walls, thallic-arthric, formed on apices of branch tips; some conidiogenous hyphae with clamp connections; similar conidia are a consistent feature of the mycelium in culture.

Habitat terrestrial (more rarely on plant debris), gregarious to cespitose, forming fairy rings in grasslands. Collections examined from Meagher county, Montana, USA: August 1993, 18 July 1997, and 8 Sept.1997. Collections and cultures located at USDA/ARS in Sidney, MT.



Figures 5-8 *Pterula subulata* conidial form. Fig. 5. Basidiocarp, bar = 5mm. Fig. 6. Conidia on branch tips, bar = 20 μm. Fig. 7. Conidia from fructifications, bar = 10 μm for Figs. 7-8. Fig. 8. Conidia on branch tip.

DISCUSSION

Initially it was not certain whether the loose, white mycelium at the apex of the fructifications was produced by the fungus itself. However, microscopic examination showed that conidiogenous hyphae were an integral part of the fruiting body. In addition, the formation of similar conidia in pure culture indicated this was a conidia-forming basidiomycete.

Asexual spores are not completely unknown in clavarioid-type fungi. A few species of *Typhula* (Typhulaceae, previously Clavariaceae) form conidia (Corner 1950; Remsburg 1940), however, the relationship between *Typhula* and *Pterula* is based on similar morphology. Recent molecular evidence suggests the relationship of *Typhula* to other clavarioid fungi should be reevaluated (Hibbett et al. 1997). That withstanding, *Typhula bulbosa* (Pat.) Corner, and *Typhula idahoensis* Remsburg (= *Typhula ishikariensis* Imai), and an unidentified *Typhula* are all reported to form conidia (Corner 1950, Remsburg 1940). *Typhula* species have been associated with serious diseases of cereals and grasses in snow and cold weather (snow-scald), while a few are saprophytic. The ecology of *Pterula* is less well known, but most species are assumed to be saprophytic on humus or plant debris (McLaughlin and McLaughlin 1972). *Typhula* is primarily a temperate genus; most *Pterula* species are tropical. Another clavarioid fungus, *Pistillaria micans* Fr. produces annelloconidia on mycelium in agar plates (Koske and Perrin 1971). A Deflexula isolate from Costa Rica forms conidia on mycelium in culture (McLaughlin and Pfeffer 1992, not in abstract). No other reports of conidia in the Clavariaceae or allied groups are known to us, although scattered reports exist for morphologically unrelated basidiomycetes.

The adaptive significance of producing both conidia and basidiospores could lie simply in increasing reproductive success by increasing propagule numbers. Diverse reproductive strategies usually merit closer scrutiny in terms of ecology and/or nuclear behavior which is mostly beyond the scope of this paper. Basidiospores are the result of meiotic processes and produce new genetic combinations to be tested by nature. Conidia are essentially "clones" of the parent, typically produced and dispersed rapidly. What is not known, in our case, is the ecological value of each reproductive mechanism. In *Pistillaria micans* Fr. the type of reproduction is affected by temperature. Sclerotium formation is enhanced at low temperatures, fruiting bodies are produced at intermediate temperatures, and conidia form at higher temperatures (Koske and Perrin 1971). This suggests each has a different ecological role. *Typhula bulbosa* forms conidia *on* sclerotia, employing two types of asexual propagules simultaneously (Corner 1950).

Nuclear condition can be a clue to reproductive value, but this is not known for our fungus. There is apparently much variation in nuclear behavior in these groups of small clavarioid fungi. *Typhula trifolii* Rostr. forms oidia on haploid mycelium, and conidia are uninucleate (Nobles 1937). *Pistillaria micans*, on the other hand, forms conidia on clamped mycelia in culture, and conidia are binucleate. In the latter case, each conidium is capable of producing a dikaryotic mycelium and subsequently fertile fruiting bodies. For sexual reproduction, mating types are basically unstudied in *Pterula*. *Pterula echo* McLaughlin and McLaughlin (1980) produces fertile fruiting bodies from single basidiospores, while a probable new species is heterothallic (D.and E. McLaughlin, pers. comm.). Researchers should be aware that diverse reproductive strategies exist in these groups of small clavarioid fungi, and be attentive to this possibility in descriptions, and ecological and genetic studies.

ACKNOWLEDGEMENT

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PROPOSED REDISPOSITION OF SCHIZOSTOMA VICINUM AND A NEWLY RECOGNIZED TAXON

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ABSTRACT

Schizostoma vicinum is transferred to *Trematosphaeria* as *T. vicina*. A second taxon is newly recognized and described as *Lophiostoma holmiorum*.

Schizostoma vicinum (Sacc.) Sacc. was one of the original species in *Schizostoma* Ces. & De Not. ex Sacc. 1878, a later homonym of *Schizostoma* Ehrenberg 1848 (Tulostomataceae). Holm and Yue (1987) illustrated and described this fungus from type material on *Quercus* from Italy. They were able to confirm the original description, even though that specimen was old and in poor condition. The ascospores are ellipsoid, 13-29 x 8-12 µm, uniseptate and somewhat constricted in the middle, vividly brown, with two oil droplets in each cell. Another example that they examined (Rehm Ascomyc. 485) on bark of *Populus nigra* from Germany had more narrowly ellipsoid ascospores. Holm and Yue suggested a possible relationship with *Trematosphaeria pertusa* (Pers.: Fr.) Fuckel, but thought the species was best accommodated in *Lophiostoma*. Berlese (1890) had provided a similar description of *Schizostoma vicinum* and illustrated small ascomata, clavate asci 85-95 x 13-15 µm, and biseriate, uniseptate ascospores, 28-30 x 8 µm.

Müller and Arx (1962) argued that *Ostropella* (Sacc.) Höhn. should replace the illegitimate name *Schizostoma*, and transferred several species including *S. vicinum* to *Ostropella*. They mentioned Berlese's illustration of the species and gave the same ascospore dimensions that he had provided. Chesters and Bell (1970) included the species in their 'Pachythele group' of species in *Lophiostoma*.

They indicated that asci were cylindric clavate with a short stipe, and ascospores biconoid, with obtusely tapered ends, a constricted central septum, each cell biguttulate, dilute brown, with a punctate wall, 28-36 x 7-10 µm. They had studied Rehm's Ascomyc. 485 and the type specimen of *Schizostoma vicinissimum* Speg 1881, which they considered to be a synonym.

Huhndorf (1993) revised some of the species that had been assigned to *Ostropella* by Müller and Arx (1962). She accepted the genus to include only the type species, *O. albocincta* (Berk. & M.A. Curtis) Höhn., and reinstated *Xenolophium* Syd. in F.L. Stev. for several taxa. Among these was *Xenolophium pachythele* (Berk. & Broome) Huhndorf, but she did not mention *Schizostoma vicinum*. She recognized that representatives of both *Xenolophium* and *Ostropella* are melanommatalean with large, superficial ascomata, peripheral stipitate asci and trabeculae. The two genera differ by variations in peridium surface structure and anatomy in longitudinal section.

Some collections from Norway conform in most respects to the description of *Schizostoma vicinum*. The gregarious ascomata, 400-500 µm diam, are immersed in decorticated wood, with the surface blackened in patches by abundant hyphae in the tissues. The blackened apical papillae are minute, slightly compressed and become pertuse. Asci are peripheral, clavate, 100-120(-140) x 12-15 µm. Trabeculae are branched and anastomosed in a gel matrix. Ascospores are bright brown, ellipsoid, 20-30 x 6-8 µm, uniseptate, somewhat constricted, with two globules and at times with a delicate septum in each hemispore. The wall may be foveolate.

This taxon agrees very closely with the information elucidated by Holm and Yue (1987). We propose a new combination in *Trematosphaeria* because of the similarities of this fungus to *T. pertusa*. *Trematosphaeria vicina* differs in more immersed, less conoid ascomata, and in ascospores that taper less to the tips, only occasionally and slowly forming additional septa, and a foveolate wall.

Trematosphaeria vicina (Sacc.) M.E. Barr & Math., comb. nov. Fig. 1A-D

Lophiostoma montellicum ssp. *vicinum* Sacc., Michelia 1: 44. 1877.

Schizostoma vicinum (Sacc.) Sacc., Michelia 1: 337. 1878.

Lophiostoma vicinum (Sacc.) Sacc., Fungi Ital. tab. 239. 1878.

Ostropella vicina (Sacc.) E. Müll., in Müller & Arx, Beitr. Kryptogamenfl. Schweiz, 11(2): 340. 1962.

Material examined. NORWAY: Nordland: Rana: Dunderlandsdalen, on *Salix glauca* L. ssp. *glauca*, 22 Jul 1989, G. Mathiassen 7607, 7610, 7612. Grane: Grane, *Salix pentandra* L., 28 Jul 1989, G M 7817 (all TROM, 7607 also in DAOM).

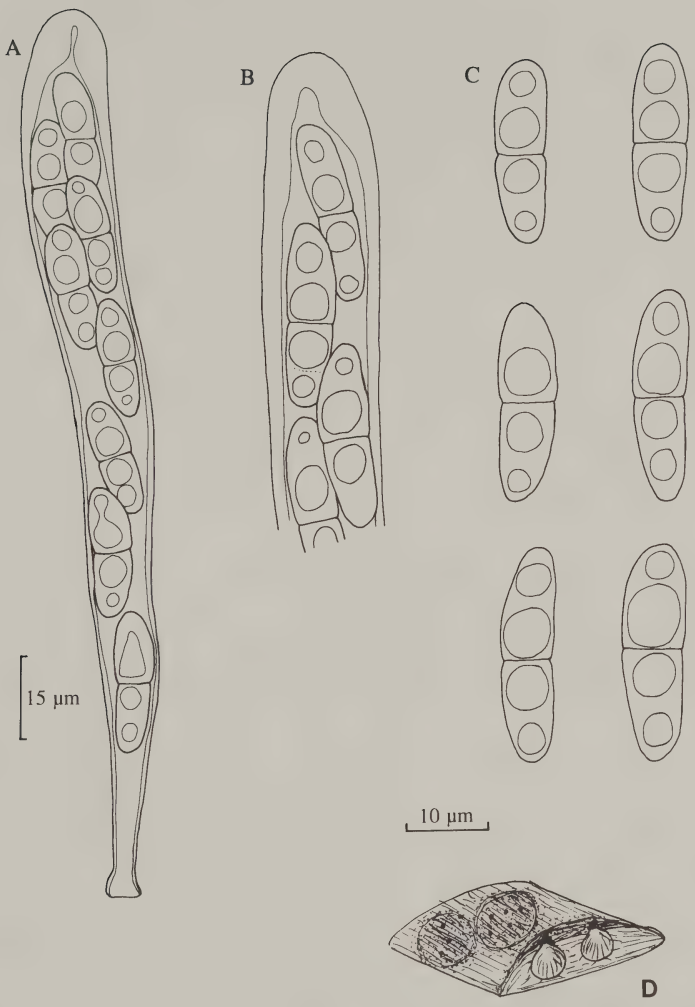


Fig. 1 A-D. *Trematosphaeria vicina*: A. Ascus. B. Ascus apex. C. Ascospores. D. Habit of ascomata in substrate. A-C as indicated by scale lines; habit sketch not to scale.

A NEWLY RECOGNIZED TAXON

In their definitive study of the Lophiostomataceae, Holm and Holm (1988) referred to the Italian and German specimens mentioned above, but described and illustrated *Lophiostoma vicinum* from a few collections made in Sweden. Ascomata are 500-600 µm, asci almost cylindrical, 140-160 x 12-16 µm, and ascospores relatively narrowly fusoid, (28-)34-48 x 8-12 µm, 1-(3-)septate, markedly constricted at the median septum, rich brown (Holm and Holm, Figs. 57, 108). This description fits specimens found in southwestern British Columbia and in Norway where ascomata are 500-600 µm, rounded or elongate, with compressed low papillae, asci 175-200 x 12-15 µm, and ascospores 40-50(-55) x 7-10 µm. Comparison of material from Canada, Norway, and Sweden leads us to conclude that these collections represent the same taxon. They differ from *Schizostoma vicinum* so strongly that they must be assigned to a separate genus and family. In *Lophiostoma,* the species epithet honors Lennart and Kerstin Holm, for their inspiring publications on pyrenomycetes.

Lophiostoma holmiorum M.E. Barr & Math., sp. nov. Fig. 2A-C

Ascomata immersa gregaria globosa vel oblonga 450-700 µm diametro, apex papillata compressa, ostiola similis rimae periphysata. Asci 140-200 x 12-18(-19) µm bitunicati fissitunicati cylindrici basali. Pseudoparaphyses cellulosae, 1.5-2.5 µm latae. Ascosporae 40-55 x 7-9(-12) µm badiae vel fuscae fusoideae 1- vel 3-5-(7-) septatae. Holotypus in ligno *Salice sitchense* Sanson ex Bong., "CANADA: British Columbia, Sidney, 20 Sep 1997" a M.E. Barr 9491 lectus in DAOM et isotypus in NY depositus.

Ascomata immersed, gregarious, globose or more often laterally elongated, 450-700 µm diam, apex short to long papillate, compressed, opening by slitlike ostiole lined with periphyses. Peridium blackened over apex, lighter reddish brown laterally and basally, composed of small slightly compressed rows of cells, 25-50 µm wide, internally pallid thin-walled rows of cells, some brown hyphae into substrate. Asci 140-200 x 12-18(-19) µm, bitunicate, fissitunicate, cylindric, basal. Pseudoparaphyses numerous, narrowly cellular, 1.5-2.5 µm wide, not in gel matrix. Ascospores 40-55 x 7-9(-12) µm, rich dark brown, ellipsoid to fusoid, often slightly curved, mostly 1-septate, constricted, finally 3-5-(7-)septate; wall finely verruculose in age, overlapping uniseriate to biseriate in the ascus.

Ecology: In mid-Scandinavia *Lophiostoma holmiorum* was only found on decorticated wood of *Salix*. It seems to prefer old substrate, and with the exception of GM 5833A, all collections in this area were found on rather decayed wood. It may therefore with some confidence be considered as a secondary saprobe. In addition it was often

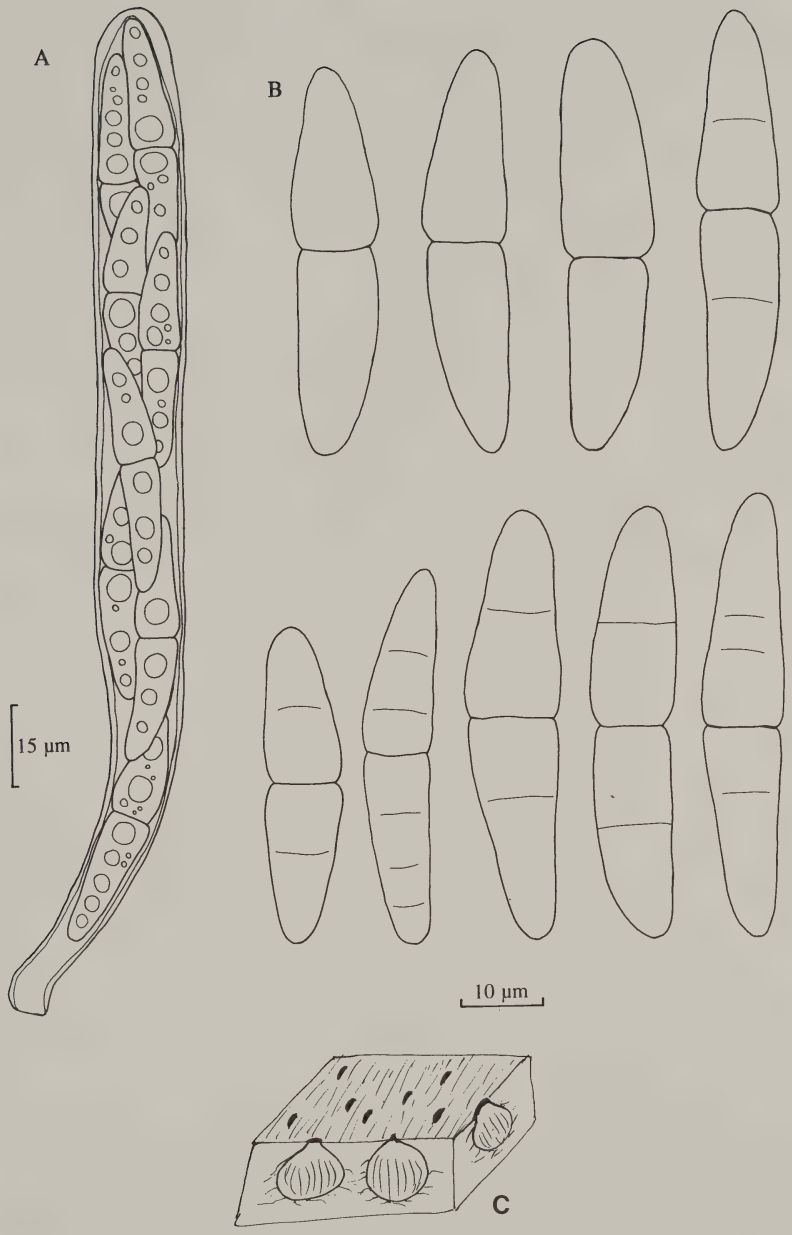


Fig. 2 A-C. *Lophiostoma holmiorum*: A. Ascus. B. Ascospores. C. Habit of ascomata in substrate. A, B as indicated by scale line; habit sketch not to scale.

collected near ground level, thus probably indicating a preference for moist conditions. The collections are too few to justify any further ecological discussion. An earlier investigation showed that several pyrenomycete species on *Salix* seem to prefer this substrate category (Mathiassen 1993). The species was only found on the *S. myrsinifolia* group, and in the southern and middle boreal regions only. The material from southern British Columbia also indicates that *L. holmiorum* is a secondary saprobe; when it developed in periderm tissues, those were aged. *Glyphium elatum* (Grev.) H. Zogg was a companion species in several of the British Columbian collections.

Distribution: *Lophiostoma holmiorum* seems to be rare in Scandinavia. Perhaps 'rarity' should refer to the numbers of mycologists who collect and recognize particular fungi. A total of 104 localities was investigated along a mid-Scandinavian transect (Mathiassen 1993) and this species was found in only five of these localities. Also Holm and Holm (1988) considered this taxon to be rare; they cited only four collections from near Uppsala, Sweden, two on *Malus domestica*, one on *Salix fragilis*, and one on *Fraxinus excelsior*. The collections made near Sidney, British Columbia, were from only six trees of *Salix sitchensis*, although numerous others were sampled. Ascomata tend to be sparse in a collection. This was true for the single collection from *Malus fusca*. No seasonality is indicated by dates of collection.

Material examined: CANADA: British Columbia, Sidney, on *Salix sitchensis*, 14 May 1990, M.E. Barr 7167, 6 Nov 1990, MEB 7370, 25 Apr 1991, MEB 7530, 5 Jun 1991, MEB 7598, 1 Jan 1992, MEB 7919, 9 Jan 1993, MEB 8346, 9 Jul 1993, MEB 8548, 12 Jul 1994, MEB 8795, 21 Apr 1996, MEB 9177, 6 Oct 1996, MEB 9233; on *Malus fusca* (Raf.) C.K. Schneid. 7 Jul 1991, MEB 7651 (all DAOM). NORWAY: Nordland: Rana: Nedre Jamtlia, on *Salix myrsinifolia* Salisb. ssp. *borealis* (Fr.) Hylander, 7 Aug 1987, G. Mathiassen 5824A, 5833A; Plurdalen, on *Salix myrsinifolia* ssp. *myrsinifolia*, 26 Jul 1989, GM 7751, 7753A, 7754, 7755A, 7756, 7757A; Vefsn: Mosjøen, on *Salix myrsinifolia* ssp. *myrsinifolia*, 28 Jul 1989, GM 7835 (TROM). SWEDEN: Uppland: Dalby par. 'Jerusalem,' on *Malus domestica* Borkh., 4 Mar 1987, K. & H. Holm 3931a (part DAOM, UPS); Åsele Lappmark: Vilhelmina: W of Lövliden, on *Salix myrsinifolia* ssp. *myrsinifolia*, 13 Jul 1988, GM 6331; Klimpfjäll near Saxån, on *Salix myrsinifolia* ssp. *myrsinifolia*, 19 Jul 1994, GM 8698A, 8703 (TROM).

A coelomycetous parasite is present in the hamathecium of several of the British Columbian collections. The small conidiomata (ca. 90 µm diam, 175 µm high) have a thin, pallid peridium. They contain many hyaline, unicellular, oblong conidia, 1.5-2 x 1 µm, that develop from small phialides that line the peridium. This fungus is difficult to classify, but appears to fit closest to *Hapalosphaeria* Syd. in Sutton (1980).

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STEREUM THINDII SP. NOV.

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SUMMARY

A new species of *Stereum* (*Stereum thindii* De, sp. nov.) has been described and illustrated. The species was found growing on a dead branch of an unknown angiosperm at Zero, Arunachal Pradesh, India.

INTRODUCTION

During a mycological excursion at Zero, Arunachal Pradesh, India, some fresh stereoid basidiocarps were collected by the author from a dead branch of an unknown angiosperm. A microscopical examination showed it to be a *Stereum* species. A search in available literature (see references) gave no clue to its identity and it was concluded that it represented an undescribed species.

Stereum thindii De, sp. nov.

Carposoma resupinato-reflexum vel pileatum; pileus 2.0 - 3.6 x 2.0 - 5.5 x 0.1 - 0.15 cm, superficies pilei tomentoso-vestita, radiatostriata; margo albido; contextus ochraceus; hymenio ochraceo, levi; systema hypharum dimiticum, hyphae generativae hyalinae, tenui-tunicatae, non-fibulatae, hyphae skeleticae hyalinae, crassetunicatae; basidia hyalina , clavata, 4-sterigmatibus, 24-30 x 4-6 μm; basidiosporae minutae, 4.8-5.6 x 2.0-2.8 μm, ellipsoideae, levis, hyalinae, tenui-tunicatae, amyloideae, apiculo prominenti, non-cyanophiles; skeletocystidia leves, crassetunicata, albido tum pallido, diam. 5.6 - 7.0 μm; pseudoacanthohyphidia, acutocystidia nulla.

ETYMOLOGIA : Secandum nomen Dr. K.S. Thind.

HOLOTYPUS : Lectus ad locum Zero, Arunachal Pradesh, India, die 21 Octobri, 1981 et positus in herbario fungorum in sectio Botanicae, Burdwan Raj College, Burdwan, West Bengal, India (sub numero BRCMH P-26); in herb. Kew conservatus.

Basidiocarp effused-reflexed to distinctly pileate; pileus 2.0-3.6 x 2.0-5.5 x 0.1-0.15 cm, tough when fresh, hard on drying, dimidiate to flabellate, often fused laterally to adjacent fruit bodies or densely imbricate, often lobed and wavy; upper surface (Fig. 1) densely woolly

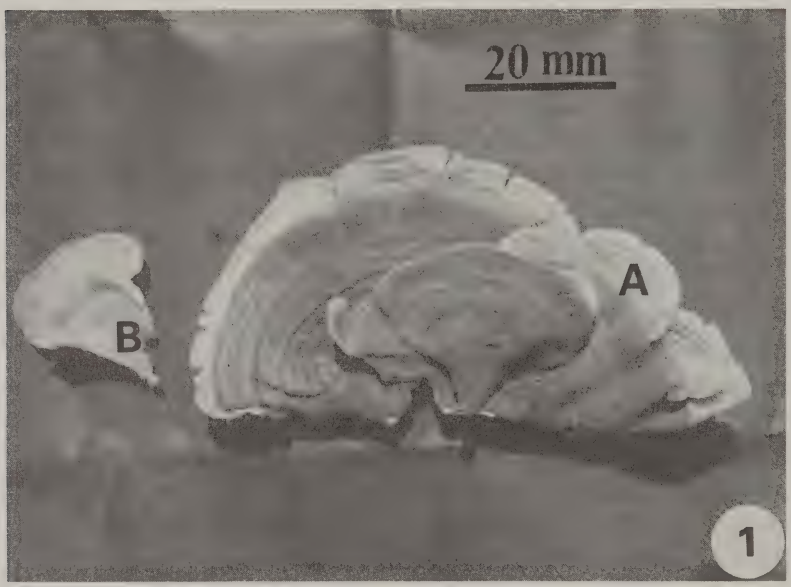
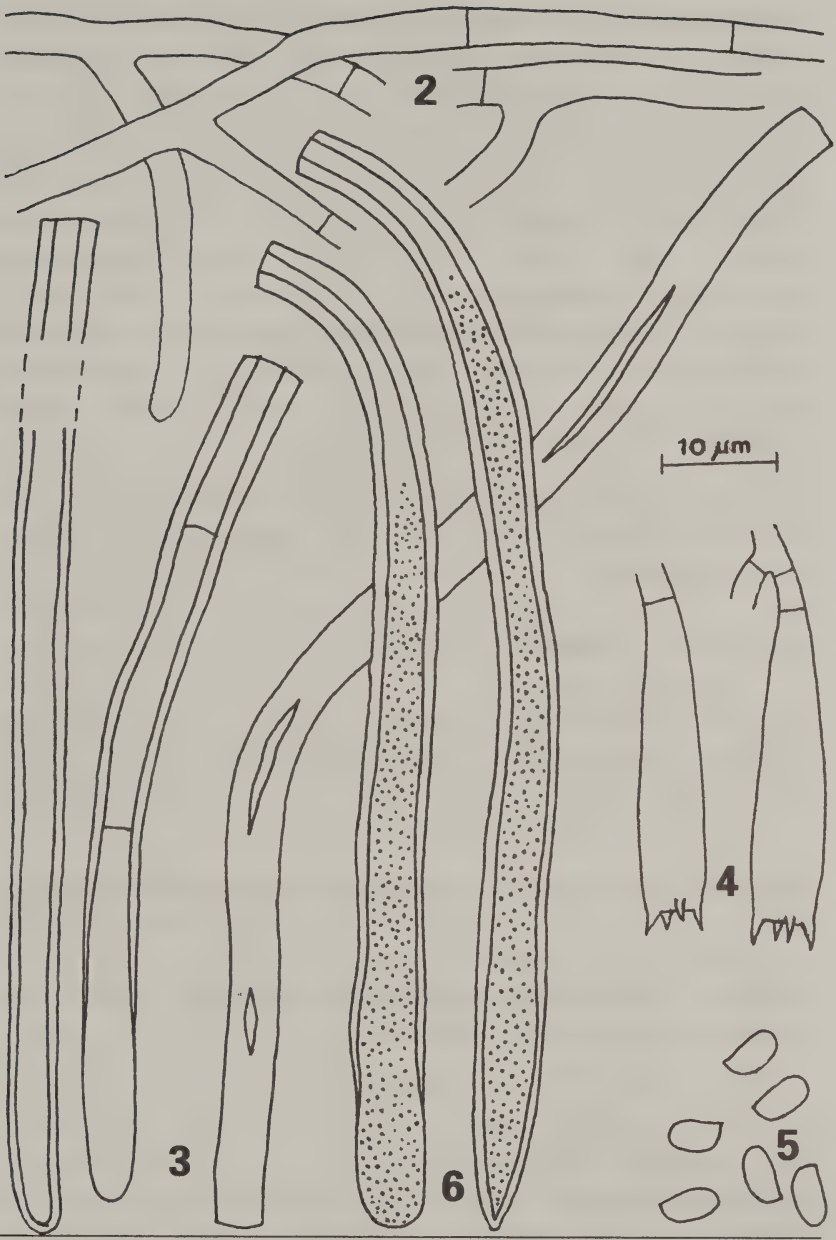


Fig. 1. *Stereum thindii* De: A. upper surface of basidiocarp; B. hymenial surface of basidiocarp (Scale = 20 mm).

tomentose, concentrically zonate, pale yellow; margin thin, acute, white, involute when dried; context ochraceous, up to 400 μm thick; separated from the tomentum by a thin brown zone; hymenial surface smooth to crisped or folded radially, ochraceous, changes to yellow when bruised in fresh material.



Figs. 2-6. Microscopic structures from basidiocarp of *Stereum thindii* : 2. Generative hyphae; 3. skeletal hyphae; 4. basidia; 5. basidiospores; 6. skeletocystidia.

Hyphal system dimitic. Generative hyphae (Fig. 2) hyaline, thin-walled, simple-septate, branched, irregularly wide, 2.5-3.5 μm in diameter. Skeletal hyphae (Fig.3) hyaline, thick-walled to solid, often with secondary septa, unbranched, apex variable, some thin-walled, others thick-walled, 3.5-5.6 μm in diameter. Basidia (Fig.4) hyaline, thin-walled, clavate, 24-30 x 4-6 μm, tetrasterigmatic with sterigmata up to 2 μm long. Basidiospores (Fig. 5) hyaline, thin-walled, smooth, ellipsoid, small, 4.8-5.6 x 2.0-2.8 μm, apiculate, amyloid and acyanophilous. Skeletocystidia (Fig. 6) abundant, arising from the trama and forming a fairly dense layer, mostly projecting above the basidia, smooth, thick-walled, hyaline to subhyaline with oily contents and roundedends, 5.6-7.0 μm wide. Acanthohyphidia, pseudo-acanthohyphidia and acutocystidia absent.

The mean size of basidiospores of specimen BRCMH P-26 is 5.17 x 2.34 μm ($S_{\overline{x}}$= 0.07; 0.04); Q = 2.0 (an average of 30 spores taken from a spore print).

TYPE OF ROT : White rot.

HOLOTYPE : BRCMH P-26, October 21, 1981. Kept in the Mycological Herbarium, Department of Botany, Burdwan Raj College, Burdwan, West Bengal, India. A portion of the specimen has been deposited in the Kew Herbarium, Richmond, Surrey, England.

TYPE LOCALITY : Zero, Arunachal Pradesh, India, 5754 ft. above sea level.

ETYMOLOGY : The species name has been coined after the celebrated mycologist of India Dr. K.S. Thind.

DISCUSSION

From the foregoing description it is evident that *Stereum thindii* De fits very well into the *Stereum* Subgenus of the genus *Stereum* (Boidin *et al.* 1979). But *Stereum thindii* is distinct from any known species of *Stereum* due to the following combination of features : (i) basidiocarp large, pileus 2.0-3.6 x 2.0-5.5 x 0.1-0.15 cm, dimidiate to flabelliform, concentrically zonate with densely woolly tomentose upper surface;

(ii) hymenial surface smooth and ochraceous which becomes yellow in fresh specimens when bruised; (iii) hyphal system dimitic with hyaline, thin-walled, simple septate generative hyphae and hyaline, thick-walled skeletal hyphae; (iv) basidiospores hyaline, thin-walled, smooth, ellipsoid, small, being 4.8-5.6 x 2.0-2.8 μm; (v) skeletocystidia smooth, hyaline to subhyaline, arising from trama and forming a dense layer beyond the hymenium; (vi) absence of acanthohyphidia, pseudo-acanthohyphidia and acutocystidia.

S. thindii shows close similarity with three species of *Stereum,* namely *Stereum ostrea* (Blume & Nees : Fr.) Fr. *[=Stereum lobatum* (Kunze : Fr.) Fr. *]*, *Stereum hirsutum* (Willd. : Fr.) S.F. Gray and *Stereum subtomentosum* Pouz. However, *S. thindii* differs from all of these three species by its smaller basidiospores. Besides, *S. thindii* is characterised by absence of acutocystidia which are abundantly present in *S. hirsutum* and *S. subtomentosum* (Eriksson *et al.* 1984). Upper surface of *S. thindii* also differs from *S. hirsutum* and *S. subtomentosum*. In *S. thindii* the upper surface is densely woolly tomentose whereas in *S. hirsutum* it is tomentose-hirsute-hispid (Eriksson *et al.* 1984, Hjortstam and Ryvarden 1990) and in *S. subtomentosum* finely adpressed tomentose to velutinous or hirsute (Eriksson *et al.* 1984). The striking difference between *S. thindii* and *S. ostrea* is the lack of pseudoacanthohyphidia in the former and their presence in the latter (Boidin 1958, Chamuris 1988).

Considering its large, pale yellow basidiocarp with dense woolly tomentose pileus surface, ochraceous hymenial surface which becomes yellow in fresh specimens when bruised, small basidiospores being 4.8-5.6 x 2.0-2.8 μm and absence of acutocystidia as well as pseudoacanthohyphidia it can easily be concluded that *S. thindii* is distinct from any known species of *Stereum*. Hence it is described here as new species.

ACKNOWLEDGEMENT

The author is greatly indebted to Dr. D.A. Reid (Kew, England) for confirming the identification of the fungus. The author is also indebted to Dr. L. Ryvarden, University of Oslo, Norway for critically reviewing the manuscript.

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MYCOTAXON

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A NEW THERMOPHILIC VARIETY OF ABSIDIA IDAHOENSIS FROM CHINA*

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ABSTRACT

A new variety of *Absidia idahoensis* Hesseltine *et al.* was isolated from a soil sample collected in China and named *A. idahoensis* var. *thermophila* G.-q. Chen & Zheng var. nov. A comparison of the morphology between the two taxa is discussed. The new variety can readily be distinguished from *A. idahoensis* var. *idahoensis* by possessing a maximum growth temperature of 48°C, while the latter fails to grow at 37°C.

KEY WORDS: *Absidia idahoensis* var. *thermophila*, *Absidia*, Mucorales, fungi, taxonomy.

摘要

喜温爱达荷犁头霉新变种 (*Absidia idahoensis* var. *thermophila* G.-q. Chen & Zheng var. nov.) 分离自我国西双版纳的土样。它因在综合毛霉培养基(SMA)上，28℃生长时菌落背面产生暗褐色色素及孢囊孢子不规则形状而与爱达荷犁头霉原变种 (*Absidia idahoensis* Hesseltine *et al.* var. *idahoensis*) 相近，并与犁头霉属内所有其他的种不同。新变种与原变种的区别主要在前者的最高生长温度为 48℃，后者为36℃。新变种的孢囊梗和囊轴在形态上与原变种也有所不同。

*The project was partially supported by the National Natural Science Foundation of China and partially supported by the United Nation Environmental Programme through its contribution to the Beijing Microbiological Resources Centre.

A fungus isolated from a soil sample collected in extreme south-western China was identified as a new variety of the species *Absidia idahoensis* Hesseltine, Mahoney & Peterson and named *A. idahoensis* var. *thermophila* var. nov. based on a comparative study with its original description and a subculture of type, CBS 103.91.

AS 3.4808, type strain of the new variety *A. idahoensis* var. *thermophila*, was obtained by using soil-plate method (Warcup, 1950) and PDA as isolating medium and incubated at 28°C for 3-4 days. Type strain of *A. idahoensis* var. *idahoensis* was supplied by the Centraalbureau voor Schimmelcultures, Baarn, Netherlands (CBS). Description of *A. idahoensis* var. *thermophila* is based on the study of AS 3.4808 grown on modified SMA (modified Synthetic *Mucor* Agar which contains dextrose 20 g, asparagine 2 g, KH_2PO_4 0.5 g, $MgSO_4 \cdot 7H_2O$ 0.25 g, thiamine chloride 0.5 mg, agar 20 g in 1000 ml distilled water) at 28°C for 4-6 days.

Absidia idahoensis Hesseltine, Mahoney & Peterson var. ***thermophila*** G.-q. Chen & Zheng var. nov. (Fig. 1; Pl. I)

Coloniae in SMA 9 cm diam. in 6 diebus ad temp. 25-30°C crescentes, ad 12°C et 49°C non crescentes, primum albae et dilute griseae, deinde luteo-ochraceae, in reverso dilute ochraceae vel dilute fulvae, in centro parce umbrino-brunneae, petaloideae; odore nullo. *Hyphae* ramosae, non-septatae, septatae in aetate, 6.5-8.5 μm diam. *Stolones* praesentes, hyalini et septati, 8.5-13(-15.5) μm diam. *Rhizoidea* simplicia vel ramosa, hyalina. *Sporophora* erecta, e stolonibus, rhizoideis non-oppositis, vel e hyphis aeriis enata et stolonoidea; axi sporophororum fere ad 480-675 μm longo, 7.5-18(-23) μm diam., aequo diam. omnino, interdum obscure attenuato, hyalino, pallide brunneo-griseolo apicaliter, laevi, simplici, monopodiali vel verticillato, interdum septato sub apophysi vel ad ramum; ramis alternis vel oppositis, vel 3-4(-5) verticillatis, 29-230(-385) μm in longitudinem, 5-9 μm diam., rectis vel leniter curvatis, simplicibus vel denuo ramosis, cum sporangio terminali. *Sporangia* globosa ad piriformia, axi alia 35-59 μm diam., lateralia 21-34 μm diam., pariete rumpente et simul deliquescente. *Apophyses* distinctae. *Columellae* variabiles, majores rotundate ovatae, parviores aculeatae, obtusae, conicae, hemisphaericae, vel alterae formae, 5-35(-50) × 7.5-35(-54) μm, hyalinae vel pallide brunneo-griseolae, laevae, leniter vel perspicue asperae, interdum cum demisso processu in apice. *Collaria* praesentia vel absentia. *Sporangiosporae* valde irregulares in forma et magnitudine, ovoideae vel oblongo-ellipsoideae, 3.5-13 × 3-8 μm, irregulares, 15.5-29 × 5-11.5 μm, hyalinae et laevae. *Chlamydosporae* absentes. *Zygosporae* ignotae.

HOLOTYPUS HMAS 73696 et **ISOTYPUS** HMAS 73697: cultura exsiccata ex AS 3.4808, isolata e terra de Xishuangbanna, Provincia Yunnan a Chen Gui-qing, 6 Julio 1994. In Herbario Mycologico Instituti Microbiologici Academiae Sinicae tenta.

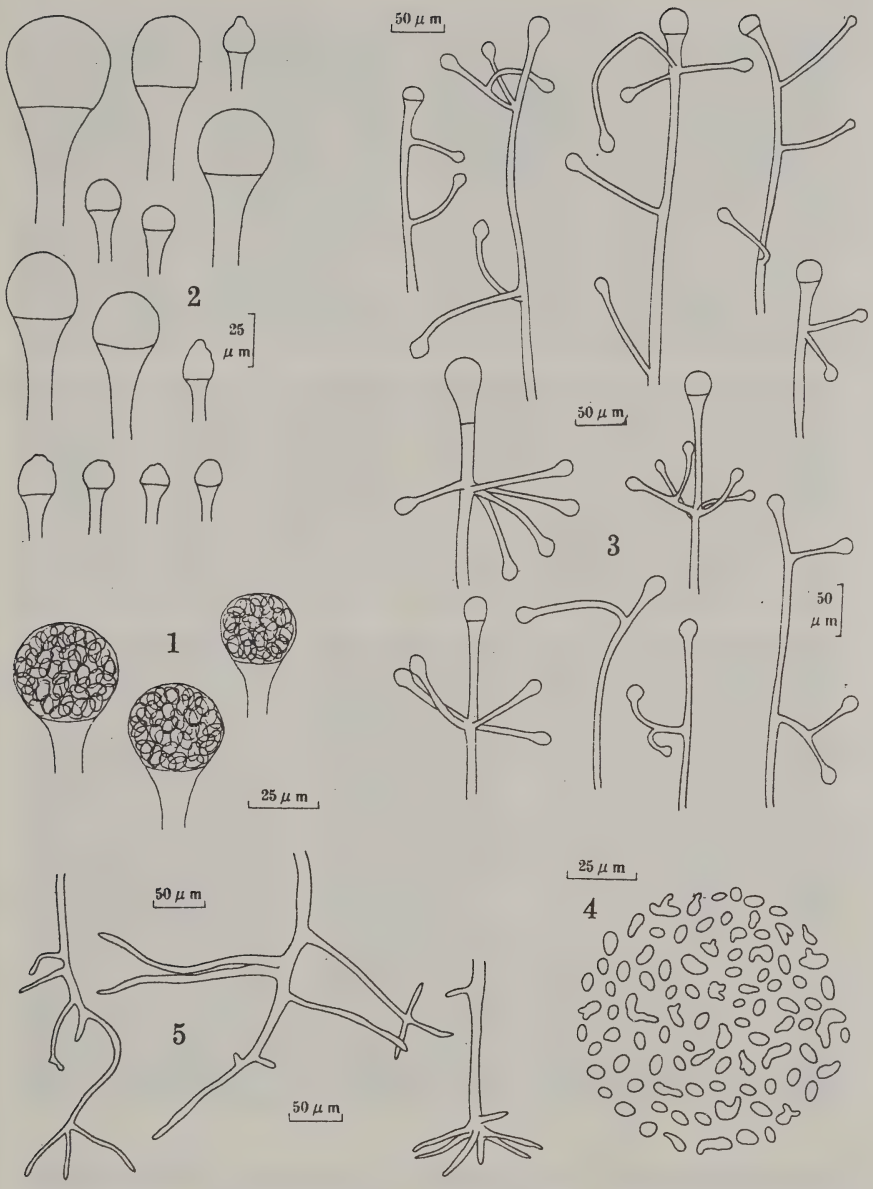
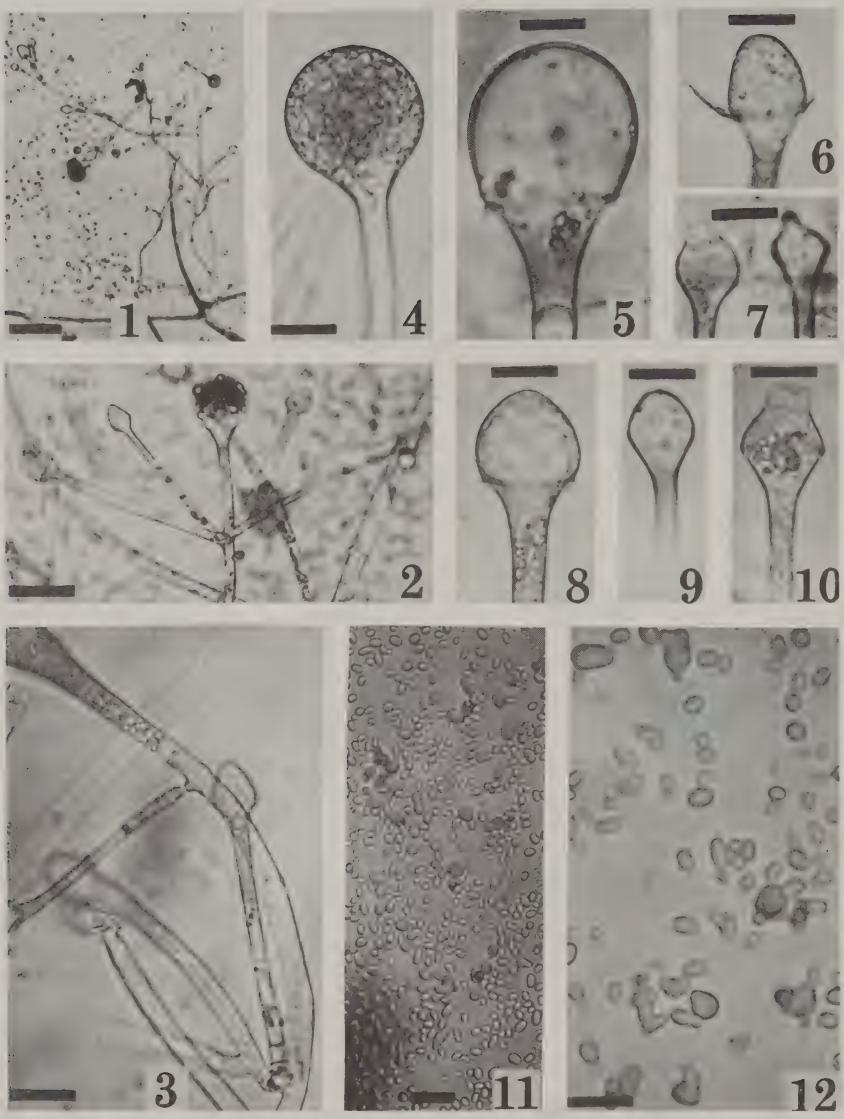


Fig. 1 *Absidia idahoensis* var. *thermophila*. 1. Sporangia. 2. Variously shaped columellae. Note that they are smooth to roughened, and sometimes have a low and broad projection at the apex (uppermost right). 3. Terminal portions of sporophores showing characteristic branching pattern. 4. Irregularly shaped sporangiospores. 5. Rhizoids. [AS 3.4808, type].



Pl. I. *Absidia idahoensis* var. *thermophila*. 1. Growing habit of the fungus and general characteristics of sporophores (bar = 100 μm). 2. Upper portion of a sporophore with verticillate branches (bar = 50 μm). 3. Upper portion of another sporophore showing septa formed above the point of branching (bar = 20 μm). 4. A terminal sporangium which is globose in shape (bar = 20 μm). 5. A columella of the terminal sporangium which is typically

Colonies growing well at 25-30°C on SMA, attaining 9 cm diam. and 1.5 cm in height by the 5th day, development ceased at 12°C or below and at 49°C or above, at first white, becoming light gray, Ivory Yellow to Colonial Buff (Ridgway XXX); reverse Pale Ochraceous-Buff to Light Buff (Ridgway XV), with small amount of pigmentation Saccardo's Umber (Ridgway XXIX) at the center, petaloid; odor none. *Hyphae* branching, nonseptate when young, septate in age, 6.5-8.5 μm diam. *Stolons* present, colorless and septate, 8.5-13(-15.5) μm diam. *Rhizoids* well developed, arising usually from the stolons, simple or branched, colorless. *Sporophores* ascending or recumbent, arising from stolons, not opposite rhizoids, or arising directly from aerial hyphae and stolon-like; main axis of sporophores usually long, up to 480-675 μm, 7.5-18(-23) μm diam., equal in width throughout, sometimes slightly attenuated upwards, hyaline, becoming pale brownish gray at the uppermost part, smooth, sometimes simple, more often monopodial or verticillate; septa when present located at a distance from the terminal sporangium or near the point of branching; branches alternate or opposite, or in verticil of 3-4(-5), short to comparatively long, 29-230(-385) μm in length, 5-9 μm diam., straight to slightly curved, simple or rebranching, all terminated with a sporangium. *Sporangia* globose to pyriform, axial ones 35-59 μm diam., lateral ones 21-34 μm diam., wall breaking and deliquescing at the same time. *Apophyses* distinct. *Columellae* variable, larger ones typically roundish oval, smaller ones pointed or obtuse, conical, hemispherical, or other shaped, 5-35(-50) × 7.5-35(-54) μm, hyaline to pale brownish gray, smooth, slightly to evidently roughened, sometimes with a low projection at the apex. *Collars* present or obsent. *Sporangiospores* very irregular in shape and size, 3.5-13 × 3-8 μm when ovoid to oblong-ellipsoid, 15.5-29 × 5-11.5 μm when irregular, hyaline and smooth. *Chlamydospores* absent. *Zygospores* unknown.

TYPE: HMAS 73696 (**holotype**) and HMAS 73697 (**isotype**), dried cultures of AS 3.4808, isolated from soil collected in Xishuangbanna, Yunnan Province, by Chen Gui-qing, 6 July 1994, are kept in the Herbarium Mycologicum Instituti Microbiologici Academiae Sinicae (HMAS), and the living culture is deposited in the culture collection of Systematic Mycology and Lichenology Laboratory and AS

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roundish-ovoid and smooth (bar = 20 μm). 6-10. Columellae of lateral sporangia (bar = 20 μm), note that they are smooth (6, 8, 9) to roughened (7 left, 10), sometimes with a low outgrowth at the apex (7 right), with distinct (6) or minute (5, 7 left & right, 8), or without collar (9, 10). 11. Sporangiospores (bar = 20 μm). 12. Same, enlarged (bar = 20 μm). [AS 3.4808, type].

Culture Collection, both of Institute of Microbiology, Academia Sinica, Beijing, China.

The new variety conforms to *A. idahoensis* var. *idahoensis*, and thus distinguished itself from all the other members in the same genus, in possessing dark brown pigmentation at the center of the colony reverse on SMA, and sporangiospores which are of the same size and either ovoid and oblong-ellipsoid or irregular in shape. However, the new variety can readily be distinguished from *A. idahoensis* var. *idahoensis* by having a maximum growth temperature of 48°C, while the latter fails to grow at 37°C.

Morphologically, the main axes and branches of sporophores are usually straight to slightly curved in *A. idahoensis* var. *thermophila*, but are often bent or circinate in *A. idahoensis* var. *idahoensis*. Branches are usually longer and more expansile in the new variety. Columellae of *A. idahoensis* var. *thermophila* are more variable, being roundish oval in the larger ones and the smaller ones may be pointed or obtuse, conical, hemispherical, or other shaped, smooth, slightly to evidently roughened, and with or without a low projection at the apex. Columellae of *A. idahoensis* var. *idahoensis* are more regular in shape, being mainly hemispherical and always smooth.

In the original description of *A. idahoensis* var. *idahoensis*, the colonies were described as being 7-8 mm high, Olive Gray to Light Mineral Gray (Ridgway LI & XLVII) by the 14th day, and having a reverse with heavy pigmentation on SMA. The type culture (CBS 103.91), however, when cultured on the same medium (SMA) under the same temperature (28°C), exhibits some differences. Colonies of CBS 103.91 are only 1-2 mm high, with very restricted growth, Ivory Yellow to Colonial Buff (Ridgway XXX) after two weeks, and the reverse shows only a small amount of pigmentation. Furthermore, in the original description (Hesseltine *et al.*, 1990), the sporangiophores of *A. idahoensis* var. *idahoensis* were said to be smooth, but are roughened in many of the sporangiohores of CBS 103.91. Nevertheless, other aspects of CBS 103.91 conform well with the original description.

ACKNOWLEDGEMENTS

The type strain of *A. idahoensis* (CBS 103.91) supplied by the Centraalbureau voor Schimmelcultures, Baarn, Netherlands (CBS) is gratefully acknowledged. We thank Ms Zhu Xiang-fei for inking the line drawing, and Ms Yuan Lan-cui for printing the microphotographs. Special thanks are due to Dr. G. L. Benny and Dr. G. L. Hennebert for reviewing and improving the manuscript.

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MYCOTAXON

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RHIZOPUS MICROSPORUS VAR. TUBEROSUS VAR. NOV.*

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ABSTRACT

Rhizopus microsporus var. *tuberosus* Zheng & G.-q. Chen var. nov. is described. Similarities and dissimilarities between or among the new variety and *R. microsporus* var. *oligosporus* (Saito) Schipper & Stalpers or the other varieties of *R. microsporus* van Tieghem, are discussed.

KEY WORDS: *Rhizopus microsporus* var. *tuberosus*, *Rhizopus*, Mucorales, fungi, taxonomy.

摘要

本文报道的块状小孢根霉新变种(*Rhizopus microsporus* van Tieghem var. *tuberosus* var. nov.) 最突出的特征为大多数假根非常退化，自匍匐菌丝的块状膨大部分以不明显的至明显的突出物出现，只有少数假根发育良好并自匍匐菌丝的正常部位发生。

与本菌最近缘的是无纹小孢根霉 [*R. microsporus* var. *oligosporus* (Saito) Schipper & Stalpers]。两者均以形状多样、直或斜生、较小的、往往明显粗糙的囊轴，以及线状条纹缺如和大小差异很大的孢囊孢子而与同种的其他变种不同。但无纹小孢根霉的假根正常且发达，孢囊孢子可长达 39微米和形态更为不规则，与块状小孢根霉新变种亦有明显差异。

*The project was partially supported by the National Natural Science Foundation of China and partially supported by the United Nation Environmental Programme through its contribution to the Beijing Microbiological Resources Centre.

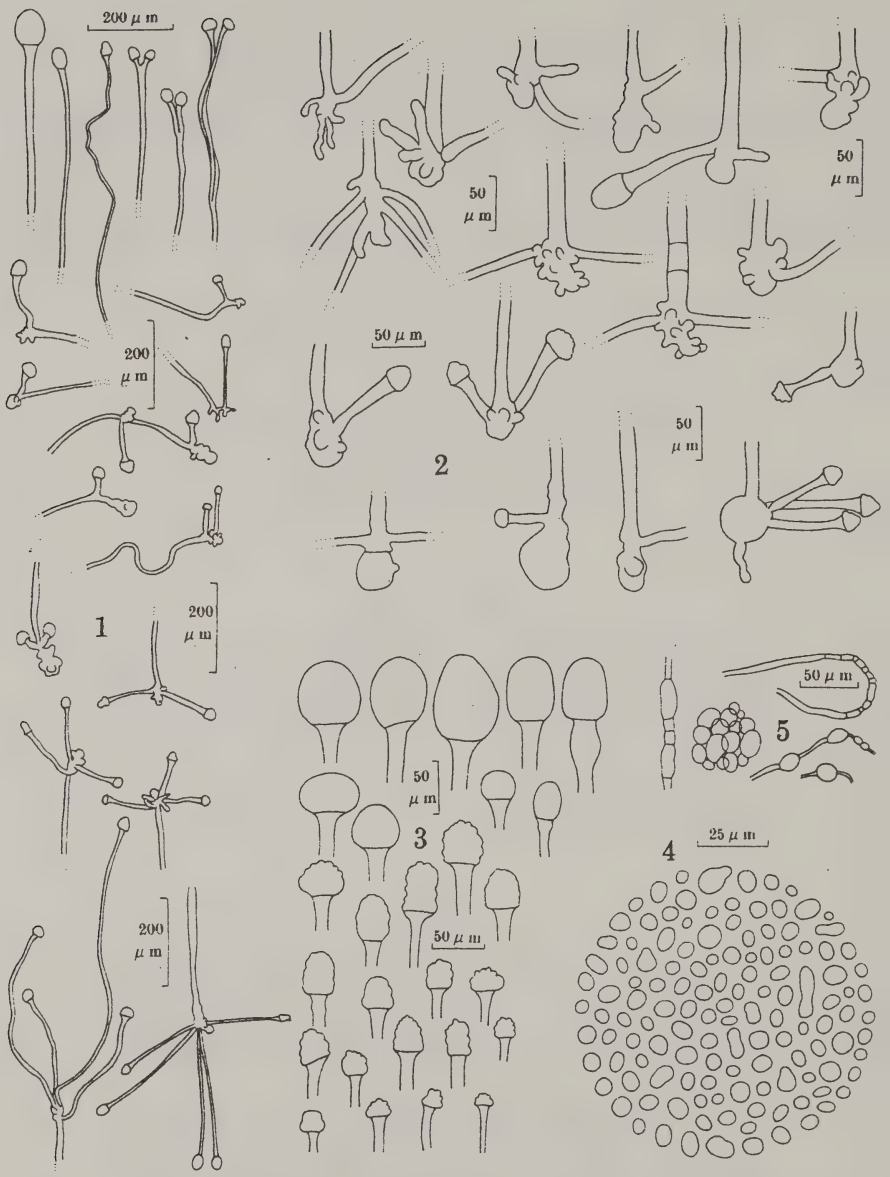


Fig. 1. *Rhizopus microsporus* var. *tuberosus*. 1. General characteristics of sporophores. Uppermost portion: sporangiophores which arise directly from aerial hyphae and without rhizoids, simple or forked. Lower portion: sporangiophores arising from stolons, with rudimentary to well developed rhizoids. 2. Enlarged basal parts of the sporophores, showing various kinds of rhizoids which are rudimentary and arise as minute or conspicuous

A strain, AS 3.1145, preserved in the AS Culture Collection, Institute of Microbiology, Academia Sinica, as *Rhizopus chinensis* Saito for many years, was studied anew and found to be an undescribed taxon.

Description of the new taxon, *R. microsporus* van Tieghem var. *tuberosus* var. nov., is based on the study of AS 3.1145 grown on PDA, 35°C, for 4 to 6 days. The strains used for crossing AS 3.1145 were supplied by the Centraalbureau voor Schimmelcultures, Baarn, Netherlands (CBS). and the medium used was YEA (yeast extract 4 g, malt extract 10 g, glucose 4 g in 1000 ml distilled water, pH 7.3), incubated at 30°C, as recommended by Schipper and Stalpers (1984).

Rhizopus microsporus van Tieghem var. ***tuberosus*** Zheng & G.-q. Chen var. nov. (Fig. 1; Pl. I)

Coloniae in PDA 9 cm diam. in 3-4 diebus ad temp. 35°C crescentes, demissae, modo 1 mm altae, fusco-griseae ad subnigras. *Stolones* 10-25 μm diam., inflati et tuberiformes in locis ubi rudimentaria rhizoidea formata, non-inflati in locis ubi normalia rhizoidea formata. *Rhizoidea* absentia vel praesentia, plerumque maxime rudimentaria, e tuberosis partibus stolonum enata, perraro eumorpha, simplicia. *Sporangiophora* directe e hyphis aeriis enata et non adversum rhizoidea, simplicia vel furcata, vel solitaria, 2-4(-5) fasciata, simplicia, plerumque ex tuberosis partibus stolonum enata, raro e non-inflatis partibus et adversum rhizoidea, brunnea, fusca, pallidiora superne, 35-200(-410) μm in longitudine, 6.5-14 μm diam., plerumque obscure sursum versus latiora, interdum in latitudine aequalia vel inaequalia, laevia, recta ad leniter curvata, aliquando inflata infra apophysim. *Apophyses* distinctae. *Sporangia* 35-95 μm diam., deliquescentia, sine collari ad columellam. *Columellae* variabiles, ovoideae, ellipsoideae, conicae, 22-60 × 18.5-55 μm, subglobosae, 18-42 μm diam., vel applanatae, 9-42 × 20-46 μm, directae vel obliquae, interdum asymmetricae, majores laeves et parviores asperae. *Sporangiosporae* heterogeneae, plerumque globosae, subglobosae vel ovatae, 5-8 μm diam. vel 5.5-10 × 5-9 μm, alterae irregulares et majores, 10.5-20 × 6.5-9 μm, non angulatae et non striatae. *Chlamydosporae* flavae, 13.5-32 μm diam. *Zygosporae* ignotae.

HOLOTYPUS HMAS 73698 et **ISOTYPUS** HMAS 73699: cultura exsiccata

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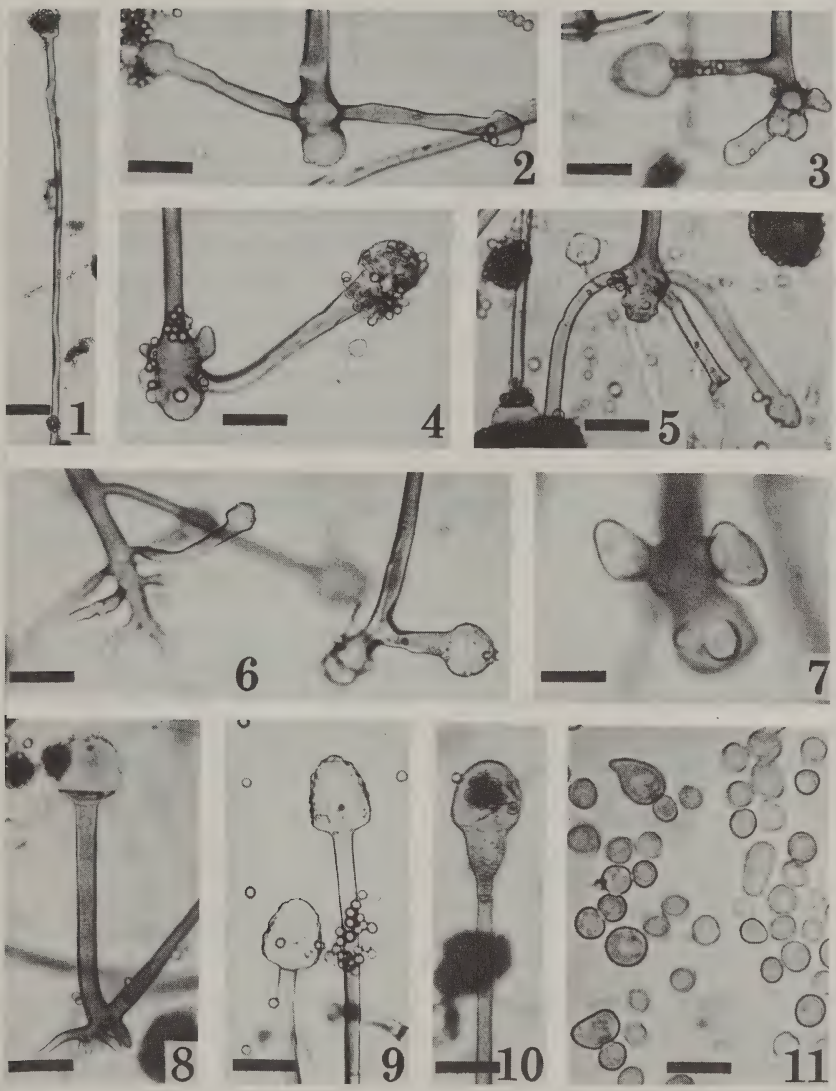
outgrowths from the tuberose part of the stolons, or well developed and arise from the normal region of the stolons. 3. Columellae of various shapes. Note that they may be straight or oblique, smooth (larger ones) or evidently roughened (smaller ones), and usually without a collar. 4. Sporangiospores of various shapes. 5. Chlamydospores which are solitary, in chains, or in mass. [AS 3.1145, type].

ex AS 3.1145, isolata e 'koji' sinici de Taishan, Provincia Guangdong, a Yue Hua-ai, 1956. In Herbario Mycologico Instituti Microbiologici Academiae Sinicae tenta.

Colonies on PDA attaining 9 cm diam. in 3-4 days at 35°C, low, only 1 mm high, dark gray to nearly black. *Stolons* well developed, light brown to brown, 10-25 μm diam., swollen and tuberose at places where rudimentary rhizoids are formed, but not swollen with normal rhizoids. *Rhizoids* absent or present, mostly very rudimentary, appearing as minute to conspicuous outgrowths from the tuberose part of the stolons, very rarely well-developed, simple, pale brown to brown, subhyaline at the distal end. *Sporangiophores* arising directly from aerial hyphae and not opposite rhizoids, simple or forked, or solitary, 2-4(-5) in groups, simple, mostly arising from the tuberose part of the stolons, rarely from the non-swollen part and opposite rhizoids, brown to dark brown, paler at the upper part, 35-200(-410) μm in length, 6.5-14 μm diam., mostly slightly widening upwards, sometimes equal throughout, smooth, straight to slightly curved, occasionally with a swelling just beneath the apophysis. *Apophyses* evident. *Sporangia* globose to subglobose, 35-95 μm diam., blackish, quickly deliquescing, usually leaving no collar. *Columellae* variable, ovoid, ellipsoid, conical, 22-60 × 18.5-55 μm, subglobose, 18-42 μm diam., or applanate, 9-42 × 20-46 μm, straight or oblique, sometimes asymmetrical, pale brown or pale grayish-brown, smooth in the larger ones and evidently roughened in the smaller ones. Sporangiospores heterogeneous in shape and size, mostly globose, subglobose to broadly ovate, 5-8 μm diam., or 5.5-10 × 5-9 μm, others irregular in shape and larger, 10.5-20 × 6.5-9 μm, neither angulate nor striate, grayish when single, dark gray in mass. *Chlamydospores* solitary, in short chain, or in mass, yellow, 13.5-32 μm diam. *Zygospores* unknown.

TYPE: HMAS 73698 (**holotype**) and HMAS 73699 (**isotype**). dried cultures of AS 3.1145, isolated from Chinese koji collected in a brewery in Taishan County, Guangdong Province, by Yue Hua-ai, 1956, are kept in the Herbarium Mycologicum Instituti Microbiologici Academiae Sinicae (HMAS), and the living culture is deposited in the culture collection of Systematic Mycology and Lichenology Laboratory and AS Cullture Collection, both of Institute of Microbiology, Academia Sinica, Beijing, China.

The most distinctive characteristic of this fungus, which distinguishes itself from all members of the genus *Rhizopus*, is that most of the rhizoids are very rudimentary and arise as minute or conspicuous outgrowths from the swollen and tuberose part of the stolons that are opposite sporophores. However, a small portion of the rhizoids are well-developed and arise from a normal portion of the stolons.



Pl. I. *Rhizopus microsporus* var. *tuberosus*. 1. A sporangiophore which arise directly from the aerial hyphae and without rhizoids (bar = 100 μm). 2-8. Sporangiophores with various kinds of rhizoids which are rudimentary and arise as minute (2, 5, right of 6), or conspicuous (3, 4, 7) outgrowths from the tuberose part of the stolons, or well developed and arise from the normal part of the stolons (left of 6, 8) (2-6, 8. bar = 50 μm; 7. bar = 20 μm). 9. Upper portions of two sporangiophores with roughened columellae (bar = 50 μm). 10. Another sporangiophore apex. (bar = 50 μm). 11. Sporangiospores (bar = 20 μm). [AS 3.1145, type].

The most closely related species is *R. microsporus* var. *oligosporus* (Saito) Schipper & Stalpers (basionym: *R. oligosporus* Saito) described from fermented glutinous rice originated from the Shandong (as 'Shan-dung') Province of China (Saito, 1905). Both fungi produce low colonies, sporangiophores that are solitary or in groups of 2-4(-5), columellae that are variously shaped, straight or oblique, and evidently roughened in the smaller ones, and sporangiospores that are nonstriate and heterogeneous. According to our study, neither oblique columellae nor heterogeneous sporangiospores are found in the other known varieties of *R. microsporus* van Tieghem, i.e. *R. microsporus* var. *microsporus, R. microsporus* var. *chinensis* (Saito) Schipper & Stalpers, *R. microsporus* var. *oligosporus* (Saito) Schipper & Stalpers, and *R. microsporus* var. *rhizopodiformis* (Cohn) Schipper & Stalpers. Likewise, according to our study, the rhizoids are much more developed, and the sporangiospores which measure up to 39 μm in length, are larger in dimension and more irregular in shape in *R. microsporus* var. *oligosporus* than those in isolate AS 3.1145. Hence, AS 3.1145 is here described as a different variety of *R. microsporus, R. microsporus* var. *tuberosus* var. nov.

When crossed with mating pairs, or other strains of *R. microsporus* var. *microsporus* [CBS 699.68 (+), CBS 700.68 (-)], *R. microsporus* var. *chinensis* [CBS 294.31 (+). CBS 631.82 (-) T], *R. microsporus* var. *oligosporus* (CBS 337.62, CBS 338.62, CBS 339.62), and *R. microsporus* var. *rhizopodiformis* [CBS 536.80 (+), CBS 343.29 (+)], no response was observed.

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CUNNINGHAMELLA CLAVATA SP. NOV., A FUNGUS WITH AN UNUSUAL TYPE OF BRANCHING OF SPOROPHORE*

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ABSTRACT

Three strains were isolated from China and described as a new species, *Cunninghamella clavata* Zheng & G.-q. Chen sp. nov. The most closely related fungus is *C. echinulata* var. *indica* Baijal & B. S. Mehrotra. Similarities and dissimilarities between or among *C. clavata* and *C. echinulata* var. *indica* or the other taxa of *Cunninghamella* are discussed. In mating experiments, the three Chinese strains of the new species did not mate with each other; none of them forms zygospores with the 56 strains of the 9 species and 2 varieties of *Cunninghamella*. All isolates of *C. clavata* reacted weakly and formed gametangia with some of the *minus* strains in our possession, thus indicating that all are of the *plus* mating type.

KEY WORDS: *Cunninghamella clavata, Cunninghamella*, Mucorales, fungi, taxonomy.

摘要

我们三次从我国西南地区的云南、贵州两省采得的基物中分离到同一种小克银汉霉属（*Cunninghamella*）真菌并定名为棒形小克银汉霉新种（*C. clavata* sp. nov.）。

新种在形态上的主要特征为：(1) 小型孢子囊全部球形。

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(2) 泡囊棒形。(3) 孢囊梗分枝方式独特，其孢子枝主轴上的初生分枝可以重复地分枝 1-3(-7) 次之多，分枝典型地互成直角，并且常常是在前一分枝的泡囊紧下面发生。(4) 泡囊上的小梗可长达11微米。在小克银汉霉属的已知种中，虽有少数种或因具有全部球形的小型孢子囊，或因具有棒形的泡囊而与棒形小克银汉霉新种有一些相似，但只有 1980 年报道的印度刺孢小克银汉霉 (*C. echinulata* var. *indica* Baijal & Mehrotra) 最为近似。由于印度刺孢小克银汉霉的模式菌种已不复存在，我们只能根据它的原始描述与我们的菌作比较。二者的孢子枝分枝上的泡囊都是棒形的，小梗可长达11微米，小型孢子囊全部球形。但在印度刺孢小克银汉霉的描述或绘图中都没有提到或绘出像棒形小克银汉霉那样的分枝方式。二者之间较为次要的区别还有，新种的孢子枝主轴上的顶生泡囊往往也是棒形的，较少其他形状，孢子枝上常有隔膜；印度刺孢小克银汉霉的孢子枝主轴上的顶生泡囊则被描述为卵形至宽棒形，有时球形，此外，孢子枝上亦未描述有隔膜。

对中国的三株棒形小克银汉霉进行相互配合，或将它们与56株属于同属11个种和变种的具强配合力的菌系进行相互配合，均无接合孢子形成，但三者均分别与其中一些负配合型的菌系有弱反应并形成配子囊。因此，这三株菌都是正配合型。

根据我们研究组其他成员对小克银汉霉属的许多菌系进行的 rDNA 的 ITS区的 PCR产物长度测定，棒形小克银汉霉的两株菌以及刺孢小克银汉霉原变种 (*C. echinulata* var. *echinulata*) 和轮生刺孢小克银汉霉 [*C. echinulata* var. *verticillata* (Paine) Zheng & G.-q. Chen] 各三株菌的平均长度(bp) 分别是 750±14.0, 890±7.5, 和 915±7.6, 可见棒形小克银汉霉与刺孢小克银汉霉或其变种的关系都不密切。因此，尽管棒形小克银汉霉与印度刺孢小克银汉霉形态相近，我们仍然不把它作为刺孢小克银汉霉的另外一个变种而把它作为一个新种。

A fungus belonging to *Cunninghamella* was isolated three times from the south-western part of China. The three strains, AS 3.4809, AS 3.5004, and AS 3.5005 represent a species similar to *C. echinulata* var. *indica* Baijal & B. S. Mehrotra (Baijal and Mehrotra, 1980), but differing in several aspects. The species is here described as new.

The strains used for describing the new species were isolated either directly from the faded flower kept in moist chamber (AS 3.4809) or by using soil-plate method (Warcup, 1950) and PDA as isolating medium (AS 3.5004 and AS 3.5005) and incubated under 28°C for 3-4 days. Morphological studies were based on fructifications grown on modified SMA (modified

Synthetic *Mucor* Agar which contains dextrose 20 g, asparagine 2 g, KH_2PO_4 0.5 g, $MgSO_4$ $7H_2O$ 0.25 g, thiamine chloride 0.5 mg, agar 20 g in 1000 ml distilled water) at 28°C. Reference strains from foreign countries used in the crossing experiments were obtained from the Centraalbureau voor Schimmelcultures, Baarn, Netherlands (CBS), the Institute for Fermentation, Osaka, Japan (IFO), the CAB International Mycological Institute, Egham, UK (IMI), and the USDA Agricultural Research Service Collection, Peoria, USA (NRRL); those from our own country were isolated and identified by us and kept in the culture collection of the Systematic Mycology and Lichenology Laboratory (with a Cu- prefix) or the AS Culture Collection (with acronym AS), both of Institute of Microbiology, Academia Sinica. Crossing experiments were carried out on PDA at 25°C.

Cunninghamella clavata Zheng & G.-q. Chen sp. nov. (Figs. 1-2; Pl. I)

Coloniae in SMA 9 cm diam. in 5-6 diebus ad temp. 28°C crescentes, circa 1-1.5 cm altae, floccosae, primo albae, deinde pallide griseolae, inverse cremeae. *Hyphae* ramosae, non-septatae, tarde septatae, 3.5-9.5(-12.5) μm diam. *Stolones* praesentes. *Rhizoidea* copiosa, saepe ramosa. *Sporophora* erecta, recta vel recurvata, e stolonibus, interdum rhizoideis opposita, vel e hyphis aeriis enata et stolonoidea, hyalina, laevia; axi ramoso, aequo in latitudinem per omnes partes, interdum superne amplificante, 5.5-13.5(-18) μm diam., cum vesicula terminale, tarde septato super vel sub ramis vel ad basim ramorum; ramis primis 1-4, solitariis, binis, vel 3-4 pseudoverticillatis, numquam verticillatis, saepe 1-3(-7) denuo ramosis, ramis secundariis typice in dextero angulo et infra vesiculam enatis, (35-)100-800 μm longis, 4.5-10.5 μm latis, rectis, cum vesicula apicali praeditis. *Vesiculae* clavatae, in axi perraro subovoideae ad irregulares, (9-)18-30(-42) μm diam., in ramis (5.5-)7-18.5(-31) μm diam., hyalinae. *Sporangiola* in pedicellis 2.5-9(-11) μm longis, e tota vel superdimidiata parte vesiculae enata, omnino globosa, 9.5-20(-27) μm diam., subbrunnea, spinosa, cum spinis brevibus et confertis, interdum dehiscentia. *Sporangiosporae* laeves, similes in forma et magnitudine sporangiolis. *Chlamydosporae* absentes. *Zygosporae* ignotae.

HOLOTYPUS HMAS 59495 et **ISOTYPUS** HMAS 59496: cultura exsiccata ex AS 3.4809, isolata e flore marcido de urbe Guiyang, Provincia Guizhou a Yu Ming-qiu, 11 Octobro 1985. **PARATYPUS** HMAS 74525: cultura exsiccata ex AS 3.5004, isolata e terra de Guiyang, Provincia Guizhou, a Huang Yin-xiao, 9 Julio 1992. **PARATYPUS** HMAS 74526: cultura exsiccata ex AS 3.5005, isolata e terra de Xishuangbanna, Provincia Yunnan, a Chen Gui-qing, 9 Julio 1994. Totae culturae exsiccatae in Herbario Mycologico Instituti Microbiologici Academiae Sinicae tentae.

Colonies on SMA floccose, reaching 9 cm in 5 or 6 days at 28°C, about 1-1.5 cm high, white for 5-7 days, becoming pale grayish and remaining so,

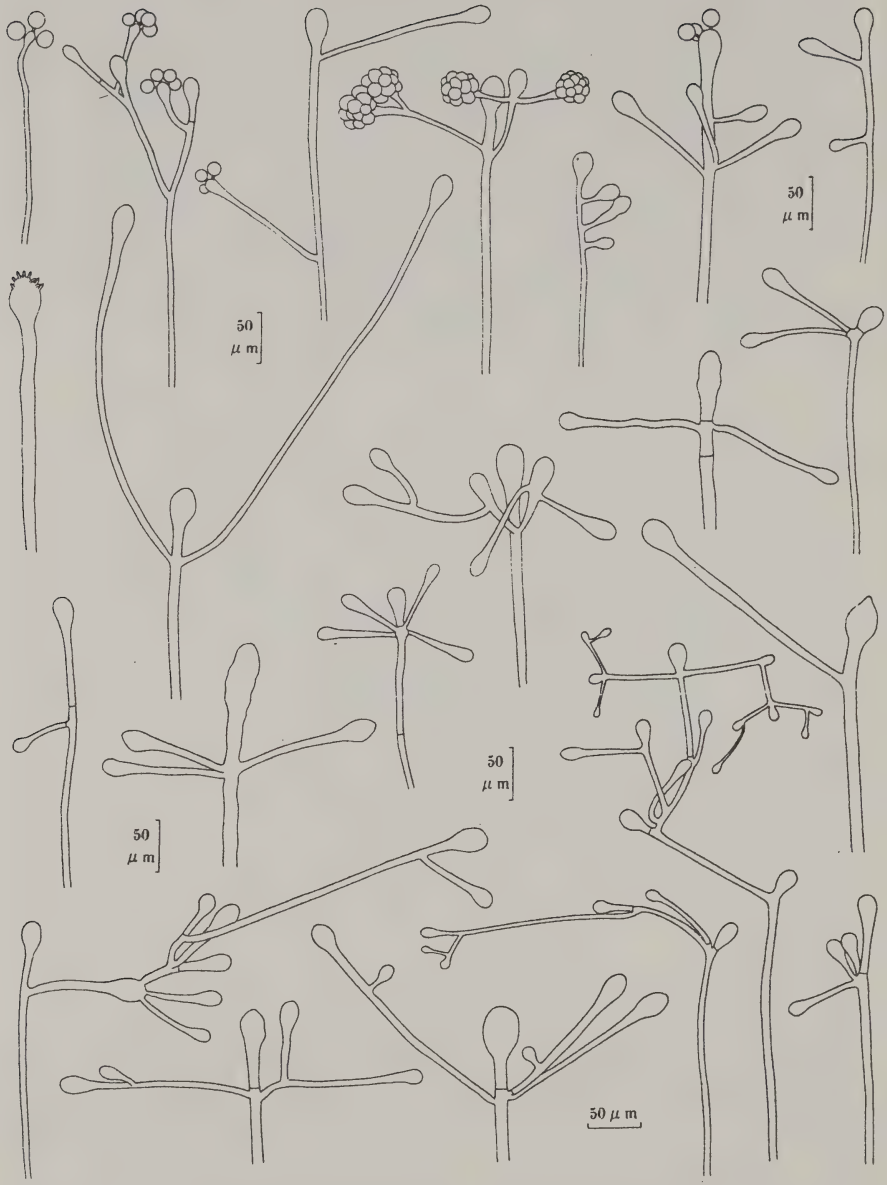


Fig. 1. *Cunninghamella clavata*. Terminal portions of sporophores showing characteristic branching patterns. [AS 3.4809, type].

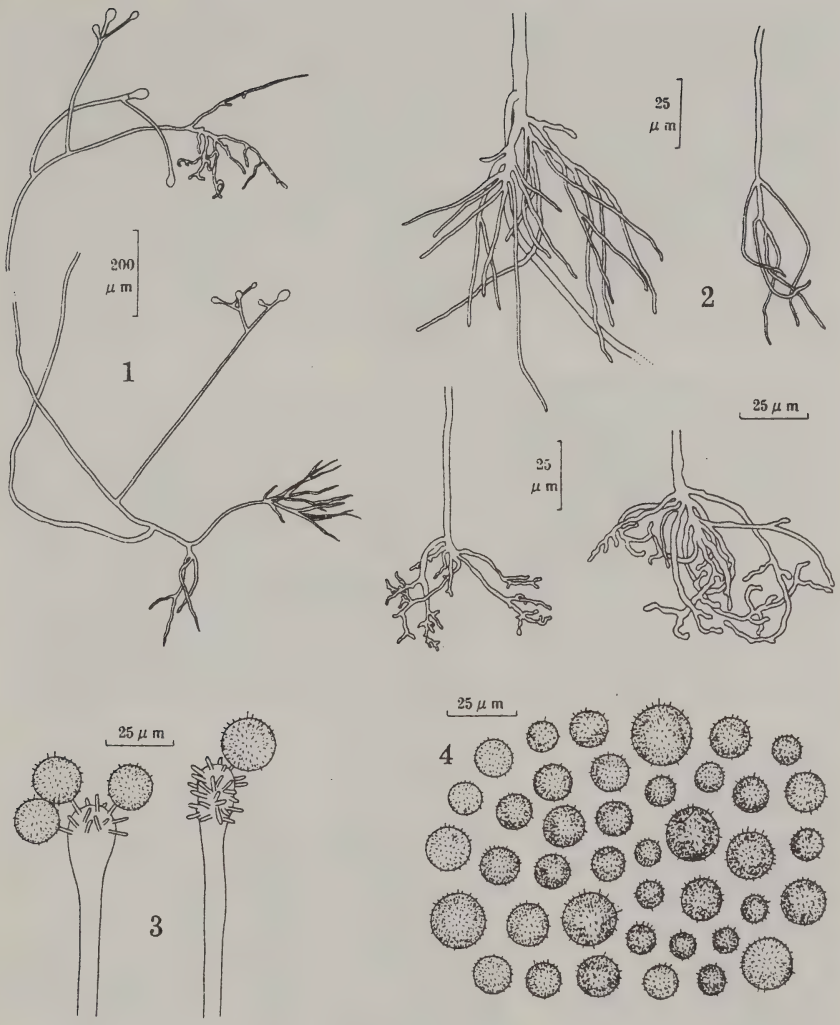
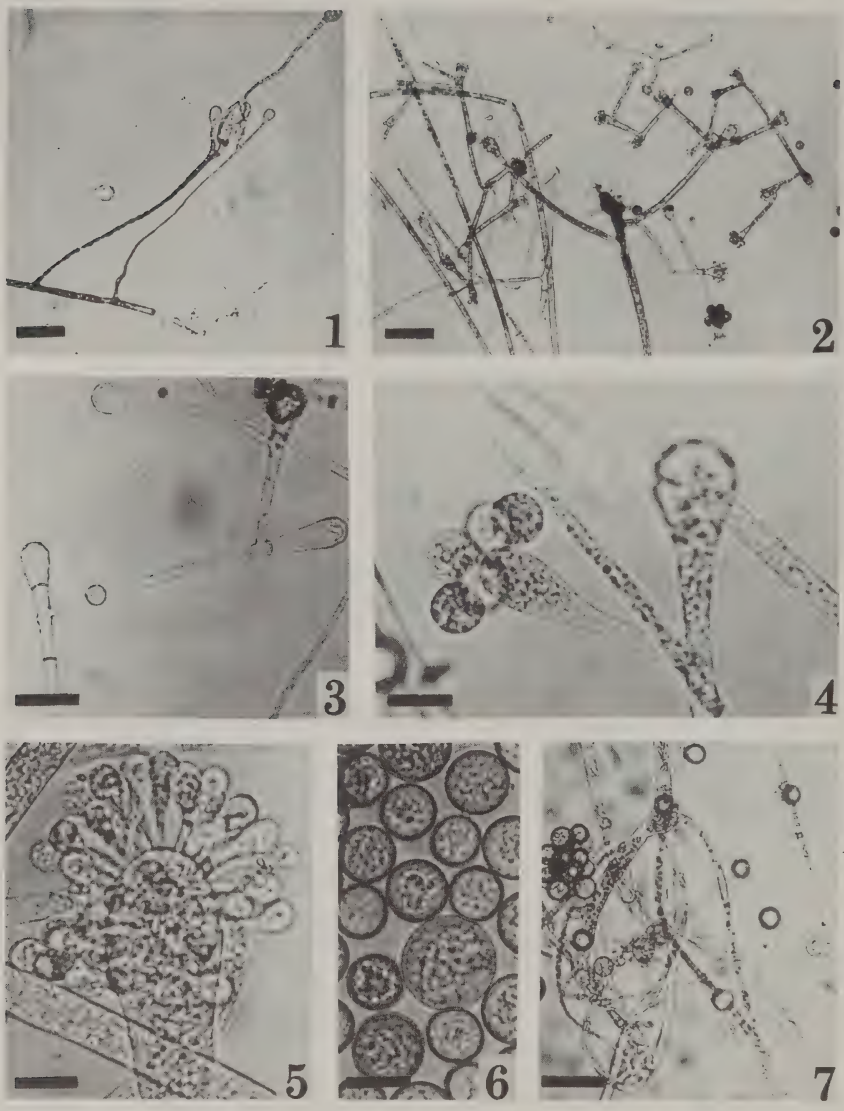


Fig 2. *Cunninghamella clavata*. 1. General habit of sporophores. 2. Rhizoids. 3. Two terminal vesicles on sporophores, one with pedicels and sporangiola (many detached) on its upper surface, the other with pedicels and sporangiola (mostly detached) on its entire surface. 4. Sporangiola. [AS 3.4809, type].



Pl. I. *Cunninghamella clavata*. 1. Sporophores on a stolon with rhizoids (bar = 100 μm). 2. Terminal portion of a sporophore with a typical branching pattern: note that the primary branches rebranch many times, typically at right angles and arising just beneath the vesicles of the former branches (bar = 100 μm). 3. Same, with less branching, and with septa on the sporophore

reverse cream. *Hyphae* branching, non-septate when young, occasionally septate in age, 3.5-9.5(-12.5) μm diam. *Stolons* usually present. *Rhizoids* abundant, long or short, simple or branched. *Sporophores* erect, straight or recumbent, arising from stolons, sometimes opposite rhizoids, or directly from aerial hyphae and stolon-like, hyaline, smooth; main axis rarely simple, usually branching, equal in width throughout, 5.5-13.5(-18) μm diam., sometimes slightly enlarging at the uppermost part, terminating in a vesicle, later septate under or above the branches or at their base; primary branches 1-4, single, in pairs, or 3-4 arranged pseudoverticillately, never verticillate, remaining simple or repeatedly branching 1-3(-7) times, subsidiary branches arising typically at right angles and just beneath the vesicle of the former branch, variable in length (35-)100-800 μm long, 4.5-10.5 μm wide, straight to slightly curved, terminating in a vesicle. *Vesicles* typically clavate, axial vesicles very rarely subovoid to irregular, (9-)18-30(-42) μm diam., lateral vesicles (5.5-)7-18.5(-31) μm diam., hyaline, with occasional proliferation. *Sporangiola* borne on pedicels measuring 2.5-9(-11) μm in length on the entire or upperhalf surface of the vesicles, strictly globose, 9.5-20(-27) μm diam., pale brown, spinose, with short, thick spines. *Sporangiospores* detachable, but usually remaining within the sporangiola, smooth, hyaline, similar in shape and size to the sporangiola bearing them. *Chlamydospores* absent. *Zygospores* unknown.

TYPE: HMAS 59495 (**holotype**) and HMAS 59496 (**isotype**), dried cultures of AS 3.4809, isolated from a faded flower collected in Guiyang, Guizhou Province, by Yu Ming-qiu, 11 October 1985; HMAS 74525 (**paratype**), dried culture of AS 3.5004, isolated from soil of a riverbank collected in Guiyang, Guizhou Province, by Huang Yin-xiao, 9 July 1992; and HMAS 74526 (**paratype**). dried culture of AS 3.5005, isolated from soil of a vegetable garden collected in Xishuangbanna, Yunnan Province, by Chen Gui-qing, 9 July 1994. All the dried cultures are kept in the Herbarium Mycologicum Instituti Microbiologici Academiae Sinicae (HMAS), and the living cultures are deposited in the culture collection of Systematic Mycology and Lichenology Laboratory and AS Culture Collection, both of Institute of Microbiology, Academia Sinica, Beijing, China.

The three strains of *C. clavata* were mated with 56 representatives or strong mating partners of 9 species and 2 varieties of *Cunninghamella*. Both AS 3.4809 and AS 3.5005 reacted weakly and formed gametangia only with

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(bar = 50 μm). 4. Two clavate vesicles with sporangiola on the upper surface of one of them (bar = 20 μm). 5. Immature sporangiola growing on long pedicels from the clavate vesicle (bar = 20 μm). 6. Sporangiola (bar = 20 μm). 7. Rhizoids (bar = 50 μm). [AS 3.4809, type].

Table 1. Mating experiments of *Cunninghamella clavata* AS 3.4809, AS 3.5004 and AS 3.5005 with strains of *Cunninghamella* spp.

Species name and strain no.	Mating type	*Cunninghamella clavata* AS 3.4809	AS 3.5004	AS 3.5005
C. antarctica Caretta & Piontelli				
CBS 545.75 T	?	——	——	——
C. bertholletiae Stadel				
CBS 693.68*	-	——	g	——
Cu-19**	+	——	——	——
Cu-96**	-	——	g	——
Cu-99**	-	——	g	——
C. blakesleeana Lendner				
CBS 133.27 T	+	——	——	——
IMI 53585	+	——	——	——
Cu-34	+	——	——	——
Cu-53	-	——	g	g
Cu-54	+	——	——	——
Cu-63	+	——	——	——
Cu-80	+	——	——	——
Cu-81	-	g	g	g
Cu-82	-	——	g	——
Cu-83	+	——	——	——
Cu-89	+	——	——	——
Cu-181	-	——	g	——
C. brunnea Rai, Agarwal & Tewari				
CBS 347.69 T***	?	——	——	——
C. echinulata (Thaxter) Thaxter ex Blakeslee var. *echinulata*				
CBS 156.28 T	+	——	——	——
IMI 199844	-	——	g	——
Cu-16	+	——	——	——
Cu-24	+	——	——	——
Cu-33	-	——	g	——
Cu-37	-	——	g	——
Cu-38	-	——	g	——
Cu-41	+	——	——	——
Cu-62	-	——	g	——
Cu-71	+	——	——	——
Cu-91	+	——	——	——
Cu-94	-	——	g	——

Species name and strain no.	Mating type	*Cunninghamella clavata* AS 3.4809	AS 3.5004	AS 3.5005
C. echinulata var. *verticillata* (F. S. Paine) Zheng & G.-q. Chen****				
CBS 134.27*****	+	——	——	——
Cu-20	-	——	g	——
Cu-22	-	——	g	——
Cu-29	+	——	——	——
Cu-30	-	——	g	——
Cu-32	+	——	——	——
Cu-47	-	——	g	——
Cu-51	+	——	——	——
Cu-57	+	——	——	——
Cu-66	+	——	——	——
Cu-73	+	——	——	——
Cu-78	-	——	g	——
Cu-88	-	——	g	——
C. elegans Lendner				
CBS 160.28 T	+	——	——	——
IMI 21199	-	——	g	——
Cu-2	-	——	g	——
Cu-10	-	——	——	——
Cu-60	-	——	——	——
Cu-61	-	——	g	——
Cu-77	-	——	g	——
Cu-104	+	——	——	——
C. homothallica Kominami & Tubaki				
IFO 6736 T	±	——	——	——
C. phaeospora Boedijn var. *phaeospora*				
CBS 692.68 T	-	——	——	——
Cu-136	-	g	g	——
C. phaeospora var. *multiverticillata* Zheng & G.-q. Chen				
Cu-137 T	+	——	——	——
C. vesiculosa Misra				
NRRL 3009 T	-	——	g	——

——: no reaction; g: forming gametangia; * received as neotype of *C. polymorpha*; ** previously published as *C. polymorpha* (Zheng and Chen, 1992); *** received as *C. phaeospora*; **** new combination of *C. blakesleeana* var. *verticillata* (Zheng and Chen, 1995-1996); ***** received as *C. echinulata*.

a few *minus* strains; AS 3.5004 likewise reacted weakly, but formed gametangia with nearly all of the *minus* strains of several species (Table 1). No zygospore was formed in any of the crosses. Also no response was detected between any pair of the three Chinese strains. All three strains are of *plus* mating type.

C. clavata is characterized by possessing: (1) strictly globose sporangiola; (2) clavate vesicles; (3) a unique branching type of the sporophores (see Pl.I.2); and (4) long pedicels that may reach 11 μm in length.

Among the species already published in *Cunninghamella, C. brunnea* Rai *et al.* (Rai, Agarwal and Tewari, 1968) and *C. intermedia* Deshpande & Mantri (Deshpande and Mantri, 1966) show some affinity to *C. clavata* by having strictly globose to subglobose sporangiola of a similar size. However, in these two species, the vesicles are globose to subglobose and not clavate, the branches are not repeatedly branched, and the pedicels are usually much shorter and never exceed 6 μm in length. Other taxa that bear some relationship to *C. clavata* include *C. echinulata* (Thaxter) Thaxter ex Blakeslee var. *echinulata* (Blakeslee, 1905), *C. homothallica* Kominami & Tubaki (Kominami, Kobayashi and Tubaki, 1952), *C. indica* Baijal & B. S. Mehrotra (Baijal and Mehrotra, 1980), *C. phaeospora* Boedijn var. *phaeospora* (Boedijn, 1958), and *C. phaeospora* var. *multiverticillata* Zheng & G.-q. Chen (Zheng and Chen, 1994). A portion of the vesicles of these taxa, i.e. the vesicles of the smaller type of fructifications in *C. echinulata* var. *echinulata*, and the vesicles of the lateral branches of the remaining taxa, are clavate or subclavate, thus resembling *C. clavata* to some extent, but their spores are not strictly globose, their branches are not repeatedly branching so many times, and do not have long pedicels. They are entirely different from *C. clavata*. Only *C. echinulata* var. *indica* exhibits strong resemblance to *C. clavata*.

The type material of *C. echinulata* var. *indica* has probably been lost. A search for its type culture, BSM C-4, was not successful. A comparison of *C. clavata* with the Indian fungus based on its description (Baijal and Mehrotra, 1980) shows that both taxa possess pale brown, strictly globose sporangiola borne on long pedicels that are up to 11 μm in length and developed on either the upper half or the entire surface of the vesicles. Like *C. echinulata* var. *indica*, most of the primary branches from the main axes of sporophores of *C. clavata* are 1-3(-4) in number, single, in pairs, or 3-4 occur pseudoverticillately. However, examination of slides prepared from various parts of the culture colony of *C. clavata* revealed that the primary

branches of sporophores branched repeatedly 1-3(-7) times, typically at right angles and arose just beneath the vesicles of the earlier branches (Pl. I, 2). In *C. echinulata* var. *indica*, no such type of branching of sporophores has been mentioned nor illustrated. Other minor differences between the two taxa include: in *C. clavata*, primary vesicles on the main axes of sporophores are often clavate, rarely subovoid to irregular and measure (9-) 18-30(-42) μm in diameter, while in *C. echinulata* var. *indica*, the primary vesicles are described as being oval to broadly clavate, sometimes globose, measuring 11-42(-49) μm in diameter. Septation is quite often present in the sporophores of *C. clavata*, but absent in those of *C. echinulata* var. *indica*.

According to the length of PCR products in the ITS region of rDNA tested by members of our Research Group (Huang *et al.*, 1998), the average length (bp) of *C. clavata* (AS 3.4809 and AS 3.5004) is 750±14.0, whilst that of *C. echinulata* var. *echinulata* (CBS 156.28, Cu-16, and Cu-38) and *C. echinulata* var. *verticillata* (F. S. Paine) Zheng & G.-q. Chen (CBS 134.27, Cu-22, and Cu-66) is 890±7.5 and 915±7.6 respectively. This indicates that neither *C. echinulata* var. *echinulata* nor *C. echinulata* var. *verticillata* is closely related to *C. clavata* and that *C. clavata* should not be treated as a variety of *C. echinulata*, though it seems to have an affinity with *C. echinulata* var. *indica*.

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TWO SIBLING SPECIES OF THE GENUS BYSSONECTRIA (PEZIZALES). SUPPRESSION OF SPORE DEVELOPMENT UNDER ENVIRONMENTAL STRESS

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The first records of *Byssonectria cartilagineum* (Kanouse et Smith) Pfister and *B. terrestris* (Alb. & Schwein.: Fr.) Pfister (Pezizales) from Estonia are presented. This represents the first report of *B. cartilagineum* outside North America. Fresh collections were used to confirm distinction between *B. cartilagineum* and *B. terrestris* growing together. A comparison of characters based on living material is given.

The number of spores in asci and the size of spores in the fruitbodies of *B. terrestris* growing at the temperature of +4°C were studied during 11 days. In a young fruitbody the cytoplasm of the ascus is used to produce a small number of spores per ascus. The spores grow at a different rates so that some of them would be mature. This may be caused by stress. Later more asci with 8 mature spores are formed. The range of spore size variability in a mature fruitbody is smaller.

Introduction

Species distinction in the genus *Byssonectria* P. Karst rely on morphological characters (spore size and shape) as well as on ecological features (= *Inermisia* Rifai, Benkert, 1987; Dennis & Itzerott, 1973; Korf, 1971, 1972; Pfister, 1993,1995; Rifai, 1968; Svrček, 1969; Yao & Spooner, 1994,1996). However, in the case of ascospore size there may

occur overlapping size ranges. This may result because ascospores are measured from herbarium material where fruitbodies may be in different stages of development. It has been stressed that since taxonomic research should be based on organs in compatible states and stages of development it is reasonable to use vital taxonomy (Baral, 1992). Pfister (1993) and Yao & Spooner (1996) suggest that measurement of discharged ascospores from fresh material can solve the problem of spore size range and delimitation of species within the genus *Byssonectria*.

The subiculum in the genus *Byssonectria* is, in fact, variable (Benkert, 1987; Yao & Spooner, 1996). It is possible that the development of the subiculum depends on the substrate (Yao & Spooner, 1996). According to Benkert (1987) it does not provide significant characters for taxonomic purpose.

The genus *Byssonectria* comprises four species: *B. cartilagineum* (Kanouse et Smith) Pfister, *B. fusispora* (Berk.) Rogerson & Korf, *B. seaveri* Pfister and *B. terrestris* (Alb. & Schwein.: Fr.) Pfister.

Pfister (1993) studied the genus *Byssonectria* from North America and established all four species. According to him ***B. terrestris*** (= Humaria *aggregata* (Berk. & Broome) Sacc.) has ascospores with a range of 18.4-25.6 x 8-9.6 µm and it forms a thin but prominent white subiculum. Typical *B. terrestris* grows on soil, on leaves and on mosses where animals have urinated. The operculate discomycete *Pseudombrophila guldeniae* Svrček (Brummelen, 1995) (= *Nannfeldtiella aggregata* Eckblad) is often found growing on the subiculum of *B. terrestris*. Benkert (1987) suggests that this is an evidence of parasitism. *B. terrestris* is circumboreal and is widely distributed (Pfister, 1993).

The simple morphology of the fruitbody and somewhat variable ascospore size have certainly contributed to the confusion of *B. cartilagineum* and *B.terrestris,* both growing in early spring (Pfister, 1993).

B. cartilagineum is characterized by ascospores with a range of 20-24 x 8-9.6 µm. It is associated with dung and has not been found together with *P. guldeniae*. The species is generally collected early in the season as snow is retreating, and it has a thick subiculum. All collections of *B. cartilagineum* originate from the western mountains of the USA and Canada.

B. fusispora is distinguished from *B. terrestris* by longer ascospores. *B. fusispora* is characterized by ascospores with a range of 24.0-29.0 x 7.0-11.0 µm, lack of a conspicuous subiculum and occurrence

on burnt areas or on scanty soil with cyanobacteria. *B. fusispora* occurs most often at middle latitudes.

B. seaveri resembles *B. fusispora* most. It is characterized by still longer ascospores, 29-36 x 8-10 µm and is found in the USA in December.

We have found two clearly different species of *Byssonectria* growing together in early spring. One grows on top of the other and develops somewhat later. The aim of this study was to use the described freshly collected specimens to confirm distinction between the species as well as to study spore measurements and shape in different stages of development.

Material and methods

In the course of this study I examined a specimen from Estonia, Tartumaa, Rahinge, growing in a nemoral spruce forest, at 26.4°: 58.23°, on ground mixed with excrements of some rodent and needles of *Picea abies* (L.) Karst., among the mosses *Cirriphyllum piliferum* (Hedw.) Grout, *Rhodobryum roseum* (Hedw.) Limpr. and *Plagiomnium affine* (Bland.) T. Kop., 22.04.1995, leg. K. Kalamees (TAA 157755).

Fresh ascomata were measured with the microscope "Amplival" and drawn by means of the drawing apparatus PA-6, using the objective 40 and the immersion objective HI 100. Tap water was used as a mounting medium. The length (l) and width (w) of spores are presented in the following form: $(l_{min})l_{mean}(l_{max})$ x $(w_{min})w_{mean}(w_{max})$ µm, where l_{mean} and w_{mean} denote the mean values of lengths and widths of 20 spores from a specimen, and l_{min}, w_{min} and l_{max}, w_{max} denote the minimum and maximum absolute values of length and width, respectively.

I studied also spore size and the number of spores in the asci of living fruitbodies growing on the substrate in a moist chamber at the temperature of +4°C in the refrigerator for 11 days.

Results and discussion

1. The size and number of ascospores in the asci of fruitbodies of *B. terrestris* growing at low temperature --

Regarding fungi, stress has been defined as any form of continuously imposed environmental extreme which tends to restrict

biomass production by most organisms in question (Cooke & Rayner, 1984).

Temperature has been shown to have an important morphological effect on the development of fungal fructifications. Ascocarp size in *Thelebolus* spp. is significantly reduced at temperature above those which allow optimal growth (15-20°C). At optimal temperatures or lower, ascocarp dimensions fell within a similar range. All isolates produced mature ascocarps at 0°C when incubation times were substantially lengthened. It is related to their ecology to grow at low temperatures. They are psychrophiles fungi (Wicklow & Malloch, 1971). Psychrophiles fungi are characterized as growing below 10°C (optimum below 20°C) (Hawksworth, Kirk, Sutton, Pegler, 1995)

The development of spores in *Byssonectria* spp. may be suppressed by low temperature when fruitbodies grow early in spring.

Since ascospore size has been used as a taxonomic character in the genus *Byssonectria* even though the species are characterized by great variability of spore size, I studied spore size and the number of spores in the asci of *B. terrestris* growing at low temperature (Table 1).

Table 1. Number of ascospores in the asci of fruitbodies of *B. terrestris* growing at the temperature of 4°C. Variability of length (l), width (w) and shape (Q - average ratio of spore length to spore width) of mature ascospores (μm).

row	date	asci	l_{min}	l_{mean}	l_{max}	w_{min}	w_{mean}	w_{max}	Q
1	26.4	4-8-spored	20.2	20.7	21.4	6.9	7.2	7.6	2.9
2	28.4	4-spored	23.9	24.5	25.2	7.6	8.0	8.2	3.1
3	28.4	6-8-spored	18.3	21.8	25.2	6.3	7.5	8.2	2.9
4	01.5	6-8-spored	22.7	24.5	25.2	7.2	8.4	9.2	2.9
5	01.5	discharged spores	21.4	23.5	25.2	6.9	7.9	8.2	3.0
6	06.5	mostly 8-spored	21.4	23.3	25.2	7.6	8.5	9.5	2.7

At first it was possible to measure only a few seemly mature spores in some asci of a young fruitbody. They were remarkably smaller (row 1) than those of an older fruitbody (rows 2-6). After two days 4- to 8-spored asci (rows 2,3) were found in one fruitbody. There were 4-spored asci with 4 mature spores. In 6-spored asci, besides mature spores, there occurred also 1 juvenile or aborted spore, while in 8-spored asci their number was 2. I measured the same fruitbody 3 days later. Now the asci were 5- to 8-spored (row 4), most of them had 8 mature spores. Four-

spored asci were not found. The mean value of spore size in 4-spored asci was higher and size variability smaller (row 2) compared with 6-and 8-spored asci, (row 3) (only mature spores were measured).

In stress conditions spores grow at a different rate so that some of them would be mature and have maximum size. In a young fruitbody the material of the ascus is used for producing a small number of spores; later more asci appear with 8 mature spores.

Although discharged spores (row 5) have somewhat higher variability than the spores measured in the asci taken from the same fruitbody, their maximum values coincide (rows 4,5).

I measured spores in another fruitbody 5 days later. Its asci were mostly 8-spored and the maximum values of spore size coincided with those measured earlier (row 6). Since the spores had not grown bigger, the established maximum could be the genetically determined maximum value for this specimen.

The range of spore variability 18.4-25.6 x 8-9.6 µm in *B. terrestris* as given by Pfister (1993) is in good accordance with the variability measured by me in developing fruitbodies during 11 days: 18.3-25.2 x 6.3-9.5 µm. Spore size variability in a mature fruitbody was lower: 21.4-25.2 x 7.6-9.5 µm (rows 6,8).

The index of spore shape in our material varied irrespective of age (Q=2.7-3.1, Table 1). It was noted also by Pfister (1993) that ascospores of *B. terrestris* attained their characteristic shape early in development but matured in size relatively slowly.

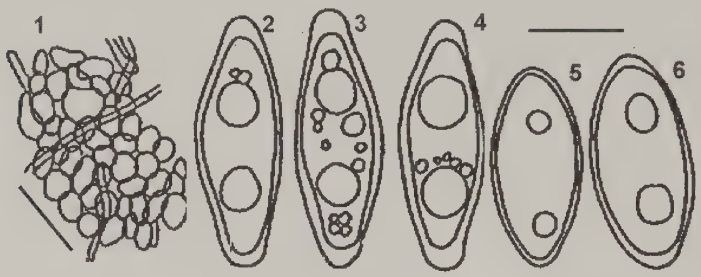
The ability of *B. terrestris* to produce mature ascospores at the temperature of 4°C is related to its growing in early spring. This species may be characterized as being 'psychrophilic' although the development of spores is at first suppressed by low temperature.

As shown above, when using spore measurements of young fruitbodies, grown in low temperature conditions, care should be taken in drawing taxonomic conclusions. This applies particularly to fungi growing at low temperature conditions in early spring, late autumn, or in mountains in the vicinity of snow.

2. Sibling species *B. cartilagineum* and *B. terrestris* --

Closely related species of plants, animal and fungi - sibling species - do not usually occur in the same site. However, this may be different in case of operculate discomycetes. Species of related genera as well as related species are often found growing close to one another provided the growth substrate, humidity and temperature conditions are adequate.

Recently we found two sibling species, *Geopora cervina* (Velen.) T. Schumach. and *G. tenuis* (Fuckel) T. Schumach., growing mixed on the ground. In the vicinity of *Aleuria aurantia* Pers. and *A. cornubiensis* (Berk. et Br.) Moravec (Moravec, 1994), two species occurring commonly close to each other, we encountered also *A. bicucullata* Boud.



Figs. 1-6. *Byssonectria cartilagineum* and *B. terrestris*.
1. Subiculum of *B. cartilagineum*. 2-4. Ascospores of *B. terrestris*. 5-6. Ascospores of *B. cartilagineum*. Bar = 100 µm in Figs. 1; bar = 10 µm in Figs. 2-6.

I had an opportunity to study the living fruitbodies of *B. cartilagineum* and *B. terrestris* growing close to each other. *B. cartilagineum* had a thick gelatinous light brown subiculum of Textura-globulosa (Fig.1) on which are situated densely clustered apothecia and in which develop young cleistohymenial apothecia as described by Pfister (1993). The subiculum was found on the ground mixed with the excrements of some rodent and needles of *Picea abies* (L.) Karst. Some mosses were growing through the subiculum: *Cirriphyllum piliferum* (Hedw.) Grout, *Rhodobryum roseum* (Hedw.) Limpr. and *Plagiomnium affine* (Bland.)T. Kop.

A very scanty greyish white subiculum of *B. terrestris* was growing on the ground near the subiculum of *B. cartilagineum*. The apothecia of *B. terrestris* developed somewhat later. Young fruitbodies of *B. terrestris* having juvenile spores were covered with the fertile spores of *B. cartilagineum*!

At first the fruitbodies of *B. terrestris* developed close to the margin of the subiculum of *B. cartilagineum*, but some days later they were seen also between the apothecia of *B. cartilagineum*. The apothecia were situated close together.

Differences in the colour of apothecia and in spore shape (Fig. 2-6) are the most useful characters for distinguishing between these two sibling species. As shown herein before, the shape of ascospores is different

already in early phases of development. A comparison of the characters is given in Table 2.

Table 2. Comparison of *Byssonectria cartilagineum* and *B. terrestris*.

	B. cartilagineum	*B. terrestris*
Subiculum	light brown 5(D-4)*, 0.6 cm thick, Textura-globulosa interwoven with Textura-intricata	greyish white 1(B-1), thin, mycelial growth made up of hair-like hyphae Textura-intricata
Apothecia	densely crowded on the subiculum, initially cleistohymenial**	loosely grouped initially cleistohymenial
Disc	convex to plane, greyish orange 5(B-3)	slightly concave to plane, deep yellow 4(A-8)
Receptacle	diam 1-1.5 mm, cylindrical, cupulate, smooth	diam up to 6 mm, obconical, tomentose towards the base
Ectal-excipulum	outer surface Textura-globulosa, following layers formed of more ellipsoidal, perpendicular, thin-walled cells	outer surface Textuta-globulosa, following layers formed of more ellipsoidal, perpendicular, thin-walled cells
Margin	Textura-globulosa	Textura-globulosa
Medullary excipulum	Textura-intricata, thin-walled hyphae 4-20 µm in diam.	Textura-globulosa + Textura-intricata, elements thin-walled 14-16 x 16-40 µm
Paraphyses	straight, slender, containing coarse orange granules, diam up to 3.8- 5.6 µm at apex	usually curved, slender, containing fine yellow granules, up to 3,2-4.8 µm at apex ***
Asci	8-spored	4-8-spored
Spores	smooth, usually 2-guttulate, fuso-ellipsoid Q=2.4 (20.2)20.8(22.1) x (8.2)8.7(9.5) µm	smooth, usually 1-2 big guttules and several smaller ones, thick-walled and truncate at poles, fusoid Q=2.8 (21.4)24.1(25.2) x (7.6)8.6(9.5) µm

* Methuen Handbook of Colour (1978); ** term by Brummelen (1967); *** after 6 days in moisture conditions in the refrigerator the apex of paraphyses enlarged up to 6.3-10 µm depending on physiological reaction to absorb water and swell up (Kullman, 1995). Therefore the diameter of paraphyses at the apex is not a useful taxonomic character.

Although this collection of *B. cartilagineum* is the first record outside North America the species is probably more widely distributed, because when studying herbarium material, *B. cartilagineum* and *B. terrestris* can be easily confused. However, the characters of living material growing in the same place showed that they are clearly distinct species.

B. terrestris is close to *B. fusispora*. The latter has bigger ascospores. Proceeding from the study of Benkert (1987) on spore measurements of 27 specimens, it is evident that *B. fusispora* described by him from Germany comprises both species. He characterized *B. fusispora* as having highly variable of ascospore size, 21-27(32) x (6.5)7.5-9.5(10) µm. Some specimens had ellipsoid ("elliptische"), and others fusoid ("spindelförmige"), spores. He presented two extreme specimens, 22-25 x 9-10 µm and 26-32 x 7-8 µm (both growing on a skin-like subiculum) but he also found all transitional forms. On the basis of continuous variability of spore size it can be concluded that these species are not diverged in Central Europe. It is possible that *B. terrestris*, *B. fusispora* and even *B. seaveri* have diverged in the course of speciation, forming a homologous series based on spore length. However, considering the high variability one of the British specimens with spores 21.0-28.0 x 7.0-9.0 µm examined by R. W. G. Dennis (Yao & Spooner, 1996), which overlaps with the spore range of *B. terrestris* and *B. fusispora* given by Pfister (1993), they may occur as natural hybrids in Europe. This problem needs further research.

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A REVISION OF THE GENERA HETEROCHAETELLA, MYXARIUM, PROTODONTIA, AND STYPELLA (HETEROBASIDIOMYCETES)

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Abstract: Nine species are described, illustrated, and referred to the genus *Stypella*. The genera *Heterochaetella* and *Protodontia* are proposed as synonyms of *Stypella*. The genus *Myxarium* is considered a synonym of *Exidia*. *Stypella mirabilis* is described as new. The new combinations *Stypella crystallina*, *S. dubia*, *S. glaira*, *S. grilletii*, *S. subgelatinosa*, *S. subhyalina*, and *Heterochaete cystidiophora* are proposed. The new species *Stypella legonii* is described, based on the invalid *Protodontia ellipsospora*. Lectotypes are proposed for *Hydnum anomalum*, *Heterochaete dubia*, *Sebacina fugacissima*, *Tremella glacialis*, and *Sebacina podlachica*. A number of new synonyms are put forward. Keys are provided to effused genera of the *Exidiales* and to species of *Stypella*.

Key words: *Stypella*, *Heterochaetella*, *Myxarium*, *Protodontia*, *Exidiales*, Heterobasidiomycetes.

A group of fungi within the *Exidiales* shares a set of distinctive characters which suggest a much closer relationship than is indicated by current taxonomic usage. The present paper proposes a more natural taxonomy for this group, reviewing both genera and species concepts on a worldwide basis.

The group is typified by the genus *Stypella* Möller. All known species are lignicolous, apparently saprotrophic, and produce multiple (typically over one hundred), geotropic basidiomes from a common but scant subicular layer at or just below the substratum surface. The individual basidiomes are highly gelatinized, possess a conspicuous surface layer of dendrohyphidia, and are fertile as soon as they are formed. The tremellaceous basidia are small, 2 - 4 celled, sphaeropedunculate, and myxarioid (the stalk becoming enucleate at maturity). With age, the individual basidiomes increase in size and either coalesce to form an effused, compound basidiome, or become contiguous but remain discrete.

Depending on the presence or absence of cystidia, the precise shape of cystidia, and the presence or absence of hyphal pegs arising from the hymenium, these fungi have hitherto been assigned to four different genera: *Stypella*, *Heterochaetella* (Bourdot) Bourdot & Galzin, *Protodontia* Höhn., and *Myxarium* Wallr. Of these, *Myxarium* is the oldest generic name. However, the type species, *Myxarium nucleatum* Wallr., is not part of the stypelloid group (see below). This leaves the genus *Stypella* as the earliest available generic name to accommodate the restructured group. The genus is therefore emended as follows:

STYPELLA Möller, Protobasid.: 77 (1895)

Protodontia Höhn., *Sitz. K. Akad. Wiss. Wien Math.-Natur. Kl.* 116: 83 (1907)
Sebacina subgen. *Heterochaetella* Bourdot, *Trans. Brit. Myc. Soc.* 7: 53 (1920)
Gloeosebacina Neuhoff, *Bot. Archiv* 8: 287 (1924)
Heterochaetella (Bourdot) Bourdot & Galzin, Hymén. de France: 51 (1928)

Basidiomes geotropic, arising from a common subiculum as multiple (typically >100), discrete, gelatinized basidiomes, each under 0.5 mm wide; individual basidiomes tufted at first, resembling small gelatinized crystals when examined under a lens; with age, individual basidiomes either remain discrete or coalesce to form an effused compound basidiome; colours hyaline to grey, often with blue or violaceous tints, sometimes opalescent white to ochraceous with age. *Hyphae* in a gelatinized matrix, narrow, 1 - 2 µm diam., thin-walled, hyaline, with clamp connexions; subicular hyphae sparse, at or just below the substratum surface; hyphae of context arising perpendicularly from subicular hyphae; sterile hyphal pegs arising from the hymenium in some species; all hyphae rapidly collapsing on drying, often agglutinated and difficult to differentiate in herbarium material. *Hyphidia* highly branched and forming a conspicuous layer above the basidia in younger specimens, tending to gelatinize and collapse in older specimens. *Cystidia* present in some species. *Basidia* 2 - 4 celled, sphaeropedunculate, 4.5 - 7.5 µm wide, myxarioid, with a long stalk which becomes enucleate at maturity. *Basidiospores* globose to cylindrical, rarely vermiform, many replicating to produce secondary basidiospores, germinating by germ tube. *Habitat* lignicolous, more rarely on dead herbaceous stems or old polypores, saprotrophic.

Type species: *Stypella papillata* Möller (= *Stypella vermiformis* (Berk. & Broome) D.A. Reid)

As emended here, the genus *Stypella* is typified by the unusual pattern of growth (the production of multiple small basidiomes from a common subiculum) supported by similarities in basidiome morphology. The sphaeropedunculate, myxarioid basidia, for example, are effectively identical in shape and size for all *Stypella* species, as are the branched dendrohyphidia and the thin-walled, clamped hyphae.

Möller (1895) established the genus for two South American species, *Stypella papillata* and *S. minor* Möller, having tremellaceous basidia and multiple discrete basidiomes whose tufted apices were composed of thin-walled cystidia or sterile hyphae. Species lacking cystidia or sterile hyphae were previously or subsequently assigned by other authors to *Sebacina* Tul. or *Tremella* Fr., both at that time treated as catch-all genera for resupinate or pustular tremellaceous fungi. Martin (1934) suggested that *Tremella grilletii* Boud. (currently referred to *Myxarium*) was

congeneric with *Stypella*, along with 'several other species now distributed among *Exidia*, *Sebacina*, and *Tremella*', but this suggestion was never taken up.

The genus *Protodontia* was established for species possessing tremellaceous basidia and odontioid or spiny basidiomes, the spines composed of sterile hyphae. This apart, the type species, *P. uda* Höhn. (= *P. subgelatinosa* (P. Karst.) Pilát), is a typical stypelloid fungus, and *Protodontia* is here proposed as a synonym of the genus *Stypella*. Most other species currently placed in *Protodontia* are excluded (see belów).

Bourdot (1920) created *Heterochaetella* as a subgenus of *Sebacina* to accommodate the species *Sebacina dubia* Bourdot. Raised to full generic rank by Bourdot & Galzin (1928), *Heterochaetella* was typified by having tremellaceous basidia and prominent fasciculate cystidia, and originally included the species *Heterochaetella crystallina* Bourdot & Galzin, a European synonym of *Stypella papillata*. Subsequently the genus was restricted to species possessing thick-walled rather than thin-walled cystidia (Luck-Allen, 1960). A difference in the thickness of cystidia walls is insufficient to maintain a separate genus, and *Heterochaetella* is here proposed as a further synonym of *Stypella*.

Gloeosebacina is a largely forgotten genus for a mixture of effused tremellaceous fungi possessing gloeocystidia. No combinations were ever proposed in the genus. Donk (1958) selected *Stypella papillata* as the lectotype.

The genus *Myxarium* was established by Wallroth (1833) for the single species *M. nucleatum*, which he included in the 'sporomycetes' believing the visible mineral inclusions to represent seeds. Following studies by Wells (1964a,b) who considered tremellaceous basidia with enucleate stalks to be cytologically distinctive and hence of taxonomic importance, Donk (1966) reintroduced Wallroth's forgotten genus to accommodate a rather arbitrary range of species possessing such 'myxarioid' basidia. Subsequently a number of species formerly placed in *Sebacina* or *Tremella* were transferred to *Myxarium* on this basis.

It now seems clear, however, that myxarioid basidia can occur in quite different tremellaceous genera, even including some lichenicolous *Tremella* species (Diederich, 1996), and may simply be a factor of basidial stalk length. Occasional myxarioid basidia can be found, for example, in *Sebacina epigaea* (Berk. & Broome) Rea where the majority of basidia are unstalked and non-myxarioid (Roberts, 1996). It is therefore here proposed that the possession of myxarioid basidia should not be considered a sole or major criterion for distinguishing genera in the *Tremellales*, though it may still play a part in distinguishing species. As a result, the genus *Myxarium* as currently conceived is heterogeneous. The type species, *M. nucleatum*, is referable to *Exidia* Fr. (see below). Most of the remaining species are referable to *Stypella*.

The majority of *Stypella* specimens examined have been collected in Britain, with additional material from continental Europe and North America, and only a handful of specimens from the tropics and the southern hemisphere. Nonetheless, it seems probable that the genus *Stypella*, as redefined here, is cosmopolitan and commonplace, even though frequently overlooked.

In the following descriptions, species are treated alphabetically and include details of selected collections examined. Type collections are cited first, followed by collections from the British Isles, then overseas collections. A key to species is provided at the end of the descriptive part, followed by notes on dubious and rejected species.

Provisional key to genera of effused *Exidiales*

Many genera and individual species have yet to be critically examined and some are undoubtedly artificial. The following should therefore be regarded as a provisional key, pending further research.

1. Surface layer of branched hyphidia in the hymenium.....2
1. No surface layer of hyphidia..... (*Exidiaceae*) 9

2. Hyphae lacking clamp connexions, occasionally dimitic; basidiomes gelatinous to coriaceous or cartlaginous, often tough, incrusting, tuberculate or with a highly irregular surface; often on ground, sometimes wholly or partly erect; basidiospores mostly ellipsoid to oblong, sometimes producing irregular, thick-walled chlamydospores; cosmopolitan.....(*Sebacinaceae*) ***Sebacina*** Tul.
2. Hyphae with clamp connexions; basidiomes (if effused) not on ground.....(*Exidiaceae*) 3

3. Mature basidia +/- fusiform, with diagonal septa; some sterigmata arising laterally; single pantropical species.....***Patouillardina*** Bres.
3. Mature basidia globose to ellipsoid or oblong; sterigmata arising +/- apically...4

4. Mature basidiome compound, gelatinous, composed of >100 individual basidiomes each under 0.5 mm diam.; individual basidiomes either remain contiguous but discrete (crystal-like under lens) or coalesce to form an odontioid, tuberculate, or smooth compound basidiome; basidia sphaeropedunculate, 4.5 - 7.5 μm wide, with enucleate stalk (myxarioid); context highly gelatinized; basidiospores subglobose to oblong, rarely vermiform.....***Stypella*** Möller
4. Mature basidiome not compound or (if so) coalescing from few, irregular basidiomes, many over 0.5 mm wide; basidia not myxarioid or (if so) larger than 7.5 μm wide; context gelatinized, coriaceous, or mineralized; basidiomes smooth to pustular or with hyphal pegs (appearing grandinioid to odontioid); basidiospores typically allantoid, less commonly ellipsoid to oblong.....5

5. Basidiomes with distinct hyphal pegs, often growing on exposed branches, most species tropical to subtropical.....***Heterochaete*** Pat.
5. Basidiomes smooth to tuberculate, on exposed or fallen wood, temperate or tropical.....6

6. Gloeocystidia present.....***Bourdotia*** (Bres.) Bres. & Torrend
6. Gloeocystidia absent.....7

7. Basidiomes gelatinous to coriaceous or mineralized, margins rarely recurved; subiculum, if present, not distinct, not of thick-walled hyphae.....
.....***Exidiopsis*** (Bref.) Möller
7. Basidiomes ceraceous to coriaceous, subiculum distinct.....8

8. Basidiomes coriaceous, with margins often recurved, sometimes partly pileate; subiculum distinct, of thick-walled hyphae.....***Eichleriella*** Bres.
8. Basidiomes ceraceous, effused, forming over a thick subiculum which appears before the hymenium.....***Fibulosebacea*** K. Wells & Raitv.

9. Basidiomes inconspicuous or consisting only of basidia-bearing hyphae trailing over substratum; hyphae often very narrow, clamped or not, not agglutinated; basidiospores oblong to fusiform or elongated vermiform.....***Serendipita*** P. Roberts
9. Basidiomes with a distinct hymenium, at least microscopically; hyphae either wide or agglutinated; cystidia often present.....10

10. Basidiomes with resupinate, poroid hymenium.....
.....***Protomerulius*** Möller (?*Elmerina* Bres.)
10. Basidiomes not poroid.....11

11. Basidiomes with markedly odontioid hymenium.....***Protohydnum*** Möller
11. Basidiomes +/- smooth, rarely weakly-tufted to reticulate.....12

12. Cystidia present; hyphae agglutinated and difficult to see clearly.....13
12. Cystidia absent; hyphae not or barely agglutinated.....14

13. Conspicuous gloeocystidia with golden-brown contents present.....
.....***Basidiodendron*** Rick
13. Hyaline cystidia present.....***Endoperplexa*** P. Roberts

14. Basidia 10 - 12 μm wide; hyphae 3 - 5 μm diam., with or without clamps; basidiospores elongated.....***Ceratosebacina*** P. Roberts
14. Basidia 3.5 - 5 μm wide; hyphae 1.5 - 2.5 μm diam., with or without clamps; basidiospores allantoid.....***Microsebacina*** P. Roberts

Stypella crystallina (D.A. Reid) P. Roberts **comb. nov.** **Fig. 1**
Myxarium crystallinum D.A. Reid, *Persoonia* 7: 293 (1973)
Myxarium granulum Hauerslev, *Mycotaxon* 49: 238 (1993)
?Myxarium gilvum Hauerslev, *Mycotaxon* 49: 238 (1993)
Myxarium subgilvum Hauerslev, *Mycotaxon* 49: 251 (1993)

Basidiomes arising as multiple small basidiomes from a common subiculum, gelatinous, hyaline to bluish or violaceous grey, resembling a mass of small crystals under a lens; with age, individual basidiomes become somewhat tufted, appearing subodontioid in the mass, but remain discrete even when contiguous. *Hyphae* in a gelatinous matrix, narrow, 1 - 2 µm diam., hyaline, highly branched, with clamp connexions, rapidly collapsing when dried. *Hyphidia* highly branched, forming a conspicuous layer above the basidia in young basidiomes, but gelatinizing and collapsing with age. *Cystidia* absent. *Basidia* consistently bisterigmate, sphaeropedunculate, 5 - 7 µm wide, myxarioid (with long stalk which becomes enucleate on maturity). *Basidiospores* subglobose to ellipsoid, a minority sometimes oblong (Q = 1.05 - 2.2), 5 - 9.5 x (3 -) 4.5 - 6.5 µm from prints, often producing secondary spores, germinating by germ tube. *Habitat* on fallen deciduous wood. *Known distribution* British Isles & Denmark.

Type specimen examined: **ENGLAND**: SURREY: Ockley, Vann Lake, on rotten stump, 22 Oct. 1972, D.A., D.G., & P.M. Reid & T. Petch, (holotype of *Myxarium crystallinum*) **K(M) 36675**.

Selected additional specimens examined: **EIRE**: Co. OFFALY: Tullamore, Charleville, on rotten *Fraxinus*?, 10 Sep. 1989, P.J. Roberts, **K(M) 9283**; **ENGLAND**: DEVON: Kingsteignton, New Cross Pond, on rotten *Salix*? branch, 10 Jun. 1989, P.J. Roberts, **K(M) 36671**; Slapton, France Wood, on fallen deciduous wood, 21 Oct. 1992, P.J. Roberts 486, **K(M) 30639**; Slapton, Marsh Lane, on fallen deciduous branch, 5 Feb. 1993, P.J. Roberts 619, **K(M) 30640**; DORSET: Sherborne, The Slopes, on *Fagus* stump, 21 Feb. 1988, A. Henrici, **K(M) 36674**; MIDDLESEX: Perivale Wood, on rotten *Salix* log, 12 Feb. 1995, A. Henrici, **K(M) 28693**; same location, on rotten *Ulmus* wood, 18 Feb. 1996, A. Henrici, **K(M) 35614**; SURREY: Englefield Green, Cooper's Hill, on rotten *Ulmus*?, 8 Nov. 1988, D.A. Reid & N.W. Legon, **K(M) 312**; Norbury Park, on old *Buxus* wood, 14 Feb. 1988, N.W. Legon, **K(M) 36673**; WARWICKSHIRE: Hay Wood, on rotten stump, 4 Oct. 1992, P.J. Roberts 476, **K(M) 30638**.

Stypella crystallina appears to be restricted to deciduous substrata, lacks cystidia, and has consistently bisterigmate basidia producing comparatively wide, mostly ellipsoid basidiospores. In all collections examined, the individual basidiomes remain discrete even when old. Basidiospores are generally wider than in *S. grilletii*, but vary considerably from subglobose to oblong within a single spore print. The species is not uncommon in southern England, and the collections cited above are only a sample of those examined.

Hauerslev (1993) described three new *Myxarium* species with bisterigmate basidia belonging to the stypelloid group. *Myxarium granulum* was distinguished from *Stypella crystallina* only by having a more strongly gelatinized texture. This must surely be a matter of water content, basidiome age, and local environmental conditions, and *Myxarium granulum* is not recognized as a distinct taxon here. *Myxarium gilvum* and *M. subgilvum* were distinguished by having basidiomes which dried to a yellowish vernicose film rather than a whitish reticulum. Again, this would seem to be a matter of basidiome age and local conditions, and accordingly *M. subgilvum* (which is otherwise identical to *S. crystallina*) is not recognized here. *Myxarium gilvum* was further distinguished by having large spores measuring '(6 -) 7 - 13 (- 14) x 4 - 6.5 µm' (Hauerslev, 1993). It may possibly represent a distinct

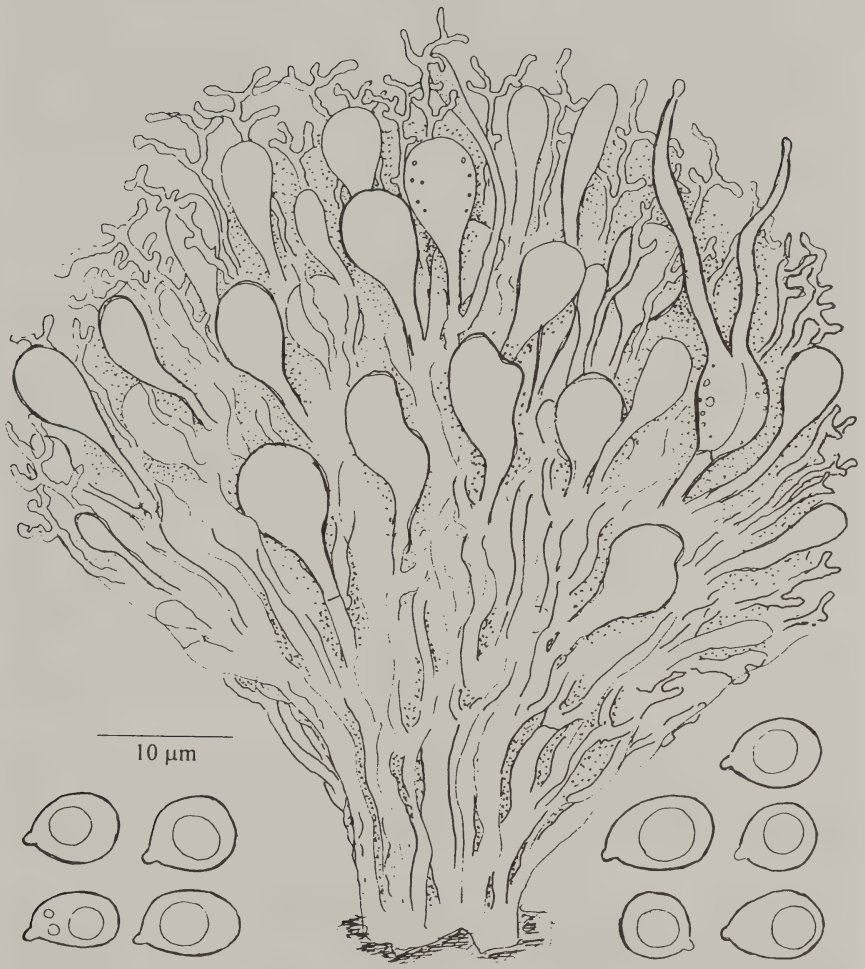


Fig. 1. ***Stypella crystallina***. Individual basidiome, showing surface layer of branched hyphidia with young and mature basidia below; basidiospores (England, K(M) 30639).

taxon, but was based on a single specimen. Given the substantial variations in spore size typical of *Stypella* species, it seems best to consider *Myxarium gilvum* a further synonym of *S. crystallina* unless additional evidence becomes available.

Stypella dubia (Bourdot & Galzin) P. Roberts **comb. nov.** **Fig. 2**
Heterochaete dubia Bourdot & Galzin, *Bull. Soc. Myc. France* 25:30 (1909)
Sebacina dubia (Bourdot & Galzin) Bourdot, *Ass. Fr. Av. Sci.* 45:576 (1922)
Heterochaetella dubia (Bourdot & Galzin) Bourdot & Galzin, Hymén.de France: 51 (1928)
Sebacina psilochaete (Bourdot & Galzin) L.S. Olive, *Bull. Torrey Bot. Club* 85: 89 (1958)
Heterochaetella brachyspora Luck-Allen, *Can. J. Bot.* 38: 566 (1960)
Heterochaetella bispora Luck-Allen, *Can. J. Bot.* 38: 563 (1960)
Sebacina pruinosa McNabb, *New Zealand J. Bot.* 7: 243 (1969)
Heterochaetella pruinosa (McNabb) Wojewoda, Mala Flora Grzybów 2: 97 (1981)

Basidiomes arising as individual basidiomes, but rapidly coalescing to form a smooth, effused, compound basidiome; abundant cystidia make the compound basidiome appear arid, athelioid, whitish to pale ochraceous with age. *Hyphae* and *hyphidia* similar to those of *S. crystallina*, but with distinctive crystalline inclusions in the context, star-like with multiple acute projections, up to 25 µm across; these appear to be produced in the subicular hyphae before basidiomes arise. *Cystidia* conspicuous, in fascicles in mature specimens, tubular, thick-walled except at the normally obtuse apex, occasionally weakly and irregularly swollen, becoming sinuous when old, up to 350 µm long in old specimens. *Basidia* 2-4 celled, otherwise similar to those of *S. crystallina*. *Basidiospores* ellipsoid to cylindrical (Q = 1.2 - 2.65), (3.5 -) 4 - 8.5 (- 9.5) x (2.5 -) 3 - 4.5 µm, frequently producing secondary spores, germinating by germ tube. *Habitat* on fallen deciduous, less frequently coniferous, wood. *Known distribution* Europe, North America, Africa, New Zealand.

Type specimens examined: **CANADA**: ONTARIO: Brant Co., S. of New Durham, on *Ulmus*, 30 Aug. 1937, R.F. Cain, (holotype of *Heterochaetella bispora*) **TRTC 17594**; **FRANCE**: AVEYRON: near Millau, Trou d'Enfer, on very rotten *Fraxinus*, 18 Apr. 1907, A. Galzin 2022 (H. Bourdot 4579), (lectotype of *Heterochaete dubia*, 3 separate packets) **PC**; same details, (iso-lectotype) **K(M) 48630**; Marvivo, May 1925, A. de Crozals 70, (holotype of *Heterochaetella brachyspora*) **BPI 719859**.

Selected additional specimens examined: **ENGLAND**: CAMBRIDGESHIRE: Cambridge, on rotten *Fraxinus*, 16 Jun. 1953, A.F. Parker-Rhodes, **K(M) 36701**; DEVON: Torquay, Watcombe Woods, on rotten deciduous trunk, P.J. Roberts 367, **K(M) 30621**; Kingsteignton, New Cross Pond, on rotten *Salix* log, 16 Dec. 1989, P.J. Roberts 75, **K(M) 18760**; Bovey Tracey, Great Plantation, on fallen *Salix* branch, 13 Apr. 1991, P.J. Roberts 193, **K(M) 16953**; same location, on fallen *Picea* branch, 16 Jun. 1991, P.J. Roberts 241, **K(M) 33188**; same location, on fallen branch, P.J. Roberts 377, **K(M) 33187**; Slapton, Duck Marsh, on *Ulmus*? log, 17 Mar. 1991, P.J. Roberts 192, **K(M) 16955**; Slapton, Marsh Lane, on fallen deciduous wood, 5 Feb. 1993, P.J. Roberts 618, **K(M) 30622**; HAMPSHIRE: New Forest, Blackhamsley Cutting, on *Betula* bark, T. Læssøe 2295, 1 Apr. 1991, **K(M) 16838**; HERTFORDSHIRE: Royston Heath, on deciduous wood, 15 Feb. 1995, K. Robinson, **K(M) 28782**; MIDDLESEX: Perivale Wood, on rotten mossy log, 9 Jan. 1994, A. Henrici, **K(M) 25400**; SURREY: Norbury Park, on dead

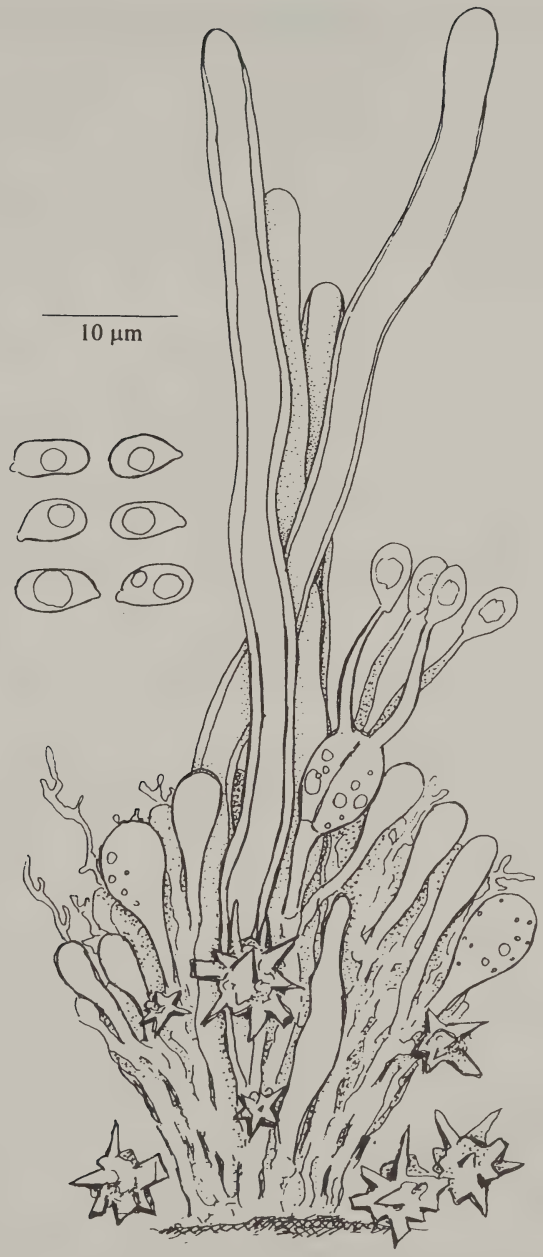


Fig. 2. ***Stypella dubia***. Basidiospores; individual basidiome, showing fasciculate, thick-walled cystidia, branched hyphidia, young and mature basidia, and stellate mineral crystals (England, K(M) 30622).

Fagus, 11 Feb. 1996, N.W. Legon, **K(M) 34951**; YORKSHIRE: Bretton Park, on fallen *Fagus*, 3 Sep. 1996, P.J. Roberts, **K(M) 39802**; **SCOTLAND**: WIGTOWNSHIRE: Ringdoo Point, on fallen *Pinus nigra* branch, 12 Sep. 1993, A. Henrici, **K(M) 24307**.

CAMEROON: S.W. PROVINCE: Korup National Park, on fallen wood, 25 Apr. 1996, P.J. Roberts K122, **K(M) 38509**; Mundemba, on fallen stick, 29 Apr. 1996, P.J. Roberts K245, **K(M) 37708**; **FRANCE**: AVEYRON: near Millau, Trou d'Enfer, on *Quercus*, 22 Nov. 1914, A. Galzin 16679 (H. Bourdot 20019), (as f. *dasychaeta*) **K(M) 48648**; Causse Noir, on *Pinus*, 30 Nov. 1913, A. Galzin 14623 (H. Bourdot 12472), **K(M) 48649**; **NEW ZEALAND**: AUCKLAND: Titirangi, Bishop's Reserve, on wood, 6 Jan. 1967, R.F.R. McNabb 25611, (as *Sebacina pruinosa*) **K(M) 48651**; **NORWAY**: OSTFOLD: Rakkestad, Berg Skogreservat, on *Picea*, 4 Oct. 1993, L. Ryvarden 33234, **K(M) 34548**; **SWEDEN**: UPPLAND: Bondkyrka parish, Vårdsätra skog, on fallen *Betula* trunk, 29 Sep. 1934, S. Lundell 1167 (Fungi Exs. Suec. 260, as var. *mesochaeta*), **K(M) 48304**.

The individual basidiomes of *S. dubia* coalesce rapidly to form effused compound basidiomes, and only a few collections have been seen where individual basidiomes are still present. The conspicuous thick-walled cystidia arise at the onset of basidiome growth and proliferate in fascicles from the original individual basidiomes. Unusually, they do not increase in length in step with hymenial growth, but rapidly outgrow the hymenium, becoming excessively long and flexuous in old specimens. These cystidia, together with the star-like mineral inclusions, are diagnostic for the species, which is common and widespread.

Based on perceived differences in the cystidia and basidiospore sizes, Bourdot & Galzin (1928) recognized six different varieties and forms of *S. dubia* which are not listed here. All are considered part of the normal variation within *Stypella dubia*. Two of the four packets of lectotype material, selected here, are marked as belonging to form '*mesochaete*'. A further authentic specimen (cited above) is marked as form '*dasychaete*'. Olive (1958) raised one of these variations to species rank as *Sebacina psilochaete*.

Luck-Allen (1960) published the new species *Heterochaetella brachyspora* based on a specimen identified by Bourdot as *H. dubia* var *mesochaeta* f. *brachyspora* Bourdot & Galzin. This specimen (cited above), and a number of others more recently collected in Britain, has rather short, ellipsoid spores (3.5 - 6.5 x 3 - 4.5 µm, Q = 1.2 - 1.6) and may possibly represent a distinct taxon. However, a range of intermediate collections exists with variable proportions of longer and shorter spores (Table 1) and the evidence at the moment suggests these are just variations within a single species.

Luck-Allen (1960) also published a second new species, *Heterochaetella bispora.* This was differentiated by having two-celled basidia, but since normal *S. dubia* has variable proportions of two and four-celled basidia, it hardly seems distinct. The type and only specimen (cited above) is in poor condition and is peculiar in having very few cystidia (only two could be found after searching several mounts, and they were both loose). It may well represent an acystidiate *Stypella* growing over the remains of *S. dubia*, in which case *Heterochaetella bispora* should be regarded as a *nomen confusum.*

McNabb (1969) differentiated *Sebacina pruinosa* on the basis of its 'paraphysoids', sterile, slightly swollen hyphae in the hymenium, and its lack of stellate mineral crystals. Spores, basidia, and cystidia were said to be the same. Examination of an authentic specimen of *Sebacina pruinosa* from New Zealand (cited above) shows it to be conspecific with *Stypella dubia*, the 'paraphysoids' appearing to be no more than thin-walled, immature cystidia.

Specimen	Spore range (µm)	Spore shape (Q)
S. dubia (type)	5.5 - 6.5 x 3 - 3.5	1.7 - 1.85
H. bispora (type)	5 - 8 x 2.5 - 3.5	1.6 - 2.6
H. brachyspora (type)	3.5 - 6.5 x 3 - 4.5	1.2 - 1.6
Roberts 75	5.5 - 9 x 3.5 - 4	1.6 - 2.5
Roberts 192	5 - 8.5 x 3 - 3.5	1.7 - 2.6
Roberts 193	3.5 - 6 x 3 - 3.5	1.25 - 1.65
Roberts 367	6 - 9.5 x 3 - 3.5	1.8 - 2.65
Roberts 377	4 - 6 x 2.5 - 3.5	1.5 - 2.2
Roberts 618	5 - 7 x 3 - 3.5	1.55 - 2

Table 1. ***Stypella dubia***. Range of size and shape in basidiospores from different collections. Type specimens measured from mounts, others from spore prints.

Stypella glaira (Lloyd) P. Roberts **comb. nov.** **Figs. 3 - 6**

Tremella glaira Lloyd, *Myc. Writ.* 5: 874 (1919)
Sebacina sphaerospora Bourdot & Galzin, *Bull. Soc. Myc. France* 39: 263 (1924)
Tremella gangliformis Linder, *Mycologia* 35: 108 (1933)
Exidiopsis glaira (Lloyd) K. Wells, *Lloydia* 20: 48 (1957)
Myxarium sphaerosporum (Bourdot & Galzin) D.A. Reid, *Persoonia* 7: 297(1973)
Myxarium leptocystidiatum Hauerslev, *Mycotaxon* 49: 243 (1993)

Basidiomes similar to those of *Stypella crystallina* when young, but the individual basidiomes expand laterally with age and then appear pustular; after further lateral growth the individual basidiomes coalesce to form an effused compound basidiome, tuberculate at first, finally becoming smooth. *Hyphae* & *hyphidia* similar to those of *S. crystallina*. *Cystidia* absent. *Basidia* similar to those of *S. dubia*. *Basidiospores* globose to broadly ellipsoid (Q = 1.0 - 1.45), 3.5 - 7.5 x 3.5 - 6.5 µm from mount of holotype; 3.5 - 6 x 3.5 - 5 µm from prints of English collections, frequently producing secondary spores, germinating by germ tube. *Habitat* on fallen deciduous or coniferous wood. *Known distribution* Europe, North America, Caribbean.

Type specimens examined: **DENMARK**: ZEALAND: Ørholm, on wood, 9 Oct. 1982, K. Hauerslev 6197, (holotype of *Myxarium leptocystidiatum*) **C 19744**; **FRANCE**: AVEYRON: Loubotis, on *Alnus*, Sep. 1914, A. Galzin 16069 (H. Bourdot) 14094, (lectotype of *Sebacina sphaerospora*), **PC**; same details, (iso-lectotype of *Sebacina sphaerospora*) **K(M) 49241**; **SWEDEN**: near Femsjö, on old moist *Pinus*, 1909, C.G. Lloyd 27070, (holotype of *Tremella glaira*) **BPI 702239**; **USA**: MISSOURI: near Fenton, 23 Mar. 1931, on saturated decaying *Ulmus* limb, D.H. Linder, (holotype of *Tremella gangliformis*) **FH**.

Selected additional specimens examined: **ENGLAND**: DEVON: Dartmoor, Yarner Wood, on fallen deciduous wood, 26 Apr. 1992, P.J. Roberts 385, **K(M) 33184**; Dartmoor, Fernworthy Forest, on rotten *Fagus* wood, 17 Oct. 1992, P.J. Roberts 477, **K(M) 33185**; KENT: Tunbridge Wells, on rotten wood, Oct. 1927, A.A. Pearson (H. Bourdot 41521), (as *Sebacina sphaerospora*) **PC**; SUSSEX: Broadwater Forest, inside old *Pinus* log, 25 Nov. 1923, A.A. Pearson, (as *Sebacina* sp.) **K(M) 48063**.

FRANCE: AVEYRON: Barthe, on *Alnus* in water, 16 Sep. 1913, A. Galzin 13855 (H. Bourdot 19780), (as *Sebacina sphaerospora*) **PC**; Beno, on *Alnus*, Dec. 1911, A. Galzin 10619 (H. Bourdot 8409C), (as *S. sphaerospora*) **PC**; Mazet, on *Alnus*, 16 Jul. 1912, A. Galzin 11649 (H. Bourdot 19777), (as *S. sphaerospora*) **PC**; Loubotis, on *Alnus*, 22 Oct. 1914, A.

Galzin 16441 (H. Bourdot 20050), (as *S. sphaerospora*) **PC**; Violette, on *Alnus* in water, Aug. 1910, A. Galzin 6791 (H. Bourdot 7471), (as *S. sphaerospora*) **PC; PUERTO RICO**: Bosque Nacional del Caribe, Bisley, on rotten wood, 6 Jun. 1997, P.J. Roberts GA183, **K(M) 51984; USA**: MASSACHUSETTS: Springfield, Forest Park, on sodden *Pinus strobus* log, 19 Aug. 1943, A.M. & D.P. Rogers 1030, (as *Sebacina podlachica*) **K(M) 49369**; OREGON: Benton Co., Chintimini, on *Pseudotsuga mucronata*, 10 Dec. 1936, A.M. & D.P. Rogers 575, (as *Sebacina sphaerospora*) **K(M) 49240**.

Stypella glaira differs from *S. grilletii* in having globose to broadly ellipsoid basidiospores (Table 2). It has also been found on coniferous wood (as in the type specimen), whereas *S. grilletii* appears to be restricted to deciduous wood. *S. glaira* is uncommon in Britain, but the few specimens seen in the field were coalesced and tuberculate, indistinguishable from *S. grilletii*.

Wells (1957) referred *Tremella glaira* to *Exidiopsis* (Bref.) Möller, having misdetermined the nature of the basidia. In a later (1979) annotation to the holotype specimen, Wells noted that 'my earlier conclusion was quite wrong. This is a...specimen of *Myxarium* or *Stypella* & has sphaeropedunculate basidia'. *Exidiopsis glaira* (Lloyd) K. Wells *sensu auct.* is the species more commonly called *Exidiopsis opalea* (Bourdot & Galzin) D.A. Reid.

Lloyd, who collected the type specimen in Sweden, originally referred his collection to *Tremella viscosa* (Schum.: Fr.) Berk. Coincidentally, Bourdot & Galzin also initially referred their specimens of *Sebacina sphaerospora* to *Tremella viscosa* (though *sensu* Pers., non Berk.). British material identified by Berkeley as '*T. viscosa*' is *Exidiopsis effusa* (Bref. ex Sacc.) Möller. The identity of the original *T. viscosa* remains unknown and the name should be regarded as a *nomen dubium.*

Sebacina sphaerospora was said to have spores '4 - 4.5 - 6 x 3.5 - 5.5 µm' (Bourdot & Galzin, 1923) and is here considered a synonym of *Stypella glaira*. The authentic specimen studied and illustrated by Reid (1973) is here selected as the lectotype (cited above, with material at both PC and K). This specimen has 'spores...3.5 - 4.75 µm...almost uniformly globose' (Reid, 1973). Seventeen additional, authentic collections of Galzin's from the Aveyron area of France have been seen (a selection of which are cited above) and appear identical to the type. Though from different locations, all were collected on *Alnus*.

Based on a re-examination of the holotype (cited above) together with the original descriptions and drawings by Linder (1933), *Tremella gangliformis* is a further synonym. The basidia are sphaeropedunculate, 6 - 7 µm wide, and the basidiospores subglobose to broadly ellipsoid (Q = 1.1 - 1.4), 4.5 - 5.5 x 3.5 - 4.5 µm (5.5 - 6 x 4 - 5 µm *fide* Linder, 1933).

Myxarium leptocystidiatum was described by Hauerslev (1993) as 'closely related to *M. sphaerosporum*, but provided with leptocystidia'. From the accompanying illustration, these clavate to cylindrical 'leptocystidia' appear to be simple elements in the hymenium, probably representing elongated or aborted probasidia, a view confirmed by a re-examination of the type specimen (cited above). Such elements are not uncommon in the hymenia of gelatinized tremellaceous fungi and are unlikely to be of taxonomic significance. *M. leptocystidiatum* is therefore considered a further synonym of *Stypella glaira*.

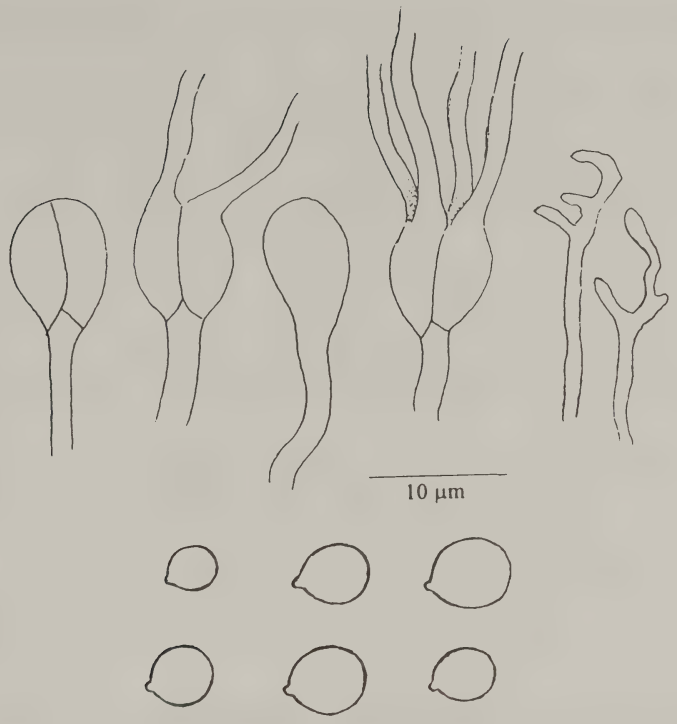


Fig. 3. ***Stypella glaira***. Basidia; branched hyphidia; basidiospores (Holotype, BPI 702239)

Specimen	Spore range (µm)	Spore shape (Q)
S. glaira (type)	3.5 - 7.5 x 3.5 - 6.5	1.0 - 1.25
S. sphaerospora (type)	3.5 - 5.5 x 3 - 4.5	1.15 - 1.4
T. gangliformis (type)	4.5 - 5.5 x 3.5 - 4.5	1.1 - 1.4
M. leptocystidiatum (type)	3.5 - 4.5 x 3 - 4	1.0 - 1.15
Bourdot 19777	3.5 - 5.5 x 3 - 4	1.05 - 1.35
Bourdot 19778	3.5 - 5 x 3 - 4.5	1.05 - 1.15
Bourdot 20055	3.5 - 6 x 3 - 5	1.1 - 1.35
Roberts 385	3.5 - 6 x 3.5 - 5	1.0 - 1.3
Roberts 477	3.5 - 6 x 3.5 - 4.5	1.0 - 1.45

Table 2. ***Stypella glaira***. Range of basidiospore size and shape in different collections. Types and overseas specimens measured from mounts, the remainder from spore prints.

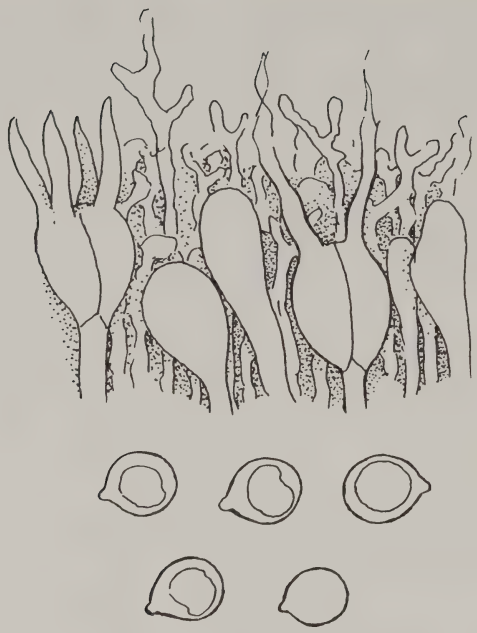
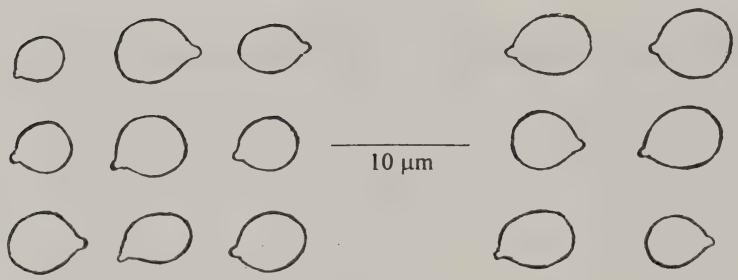


Fig. 4. ***Stypella glaira***. Section of hymenium, showing young and mature basidia; basidiospores (Holotype of *Myxarium leptocystidiatum*, C 19744)



Figs 5 & 6. ***Stypella glaira***. Basidospores (left) (Type of *Sebacina sphaerospora*, PC & K(M) 49241); (right) (Holotype of *Tremella gangliformis*, FH).

Stypella grilletii (Boudier) P. Roberts **comb. nov.** **Figs. 7 -9**

Tremella grilletii Boudier, *Bull. Soc. Bot. France* 32: 284 (1885)
Sebacina podlachica Bres., *Annls Mycol.* 1: 117 (1903)
Tremella glacialis Bourdot & Galzin, *Bull. Soc. mycol. France* 39: 261 (1923)
Sebacina crozalsii Bourdot & Galzin, Hymén. France: 38 (1928)
Exidiopsis podlachica (Bres.) Ervin, *Mycologia* 49: 123 (1957)
Sebacina gloeofilum L.S. Olive, *Bull. Torrey Bot. Club* 85: 22 (1958)
Myxarium podlachicum (Bres.) Raitv. in Parmasto, Zhiv. Prir. Dal'nego Vost. 113 (1971)
Myxarium grilletii (Boudier) D.A. Reid, *Persoonia* 7: 297 (1973)
Myxarium varium Hauerslev, *Mycotaxon* 49: 253 (1993)

Basidiomes, *hyphae*, and *hyphidia* similar to those of *S. glaira*. *Cystidia* absent. *Basidia* 2 - 4 celled, similar to those of *S. glaira*. *Basidiospores* very variable within a single print, oblong to cylindrical (Q = 1.6 - 3.2), often depressed, constricted, or suballantoid, (4 -) 5.5 - 9.5 (- 12) x (2.5 -) 3 - 4 (- 5.5) µm from prints, frequently producing secondary spores, germinating by germ tube. *Habitat* on fallen deciduous wood, more rarely on dead woody herbaceous stems or old polypores. *Known distribution* Europe, Africa, Central & North America, Polynesia.

Type specimens examined: **FRANCE:** Bordeaux, on *Populus*, Oct. 1915, A. Galzin 18518 (H. Bourdot 19820), (lectotype of *Tremella glacialis*) **K(M) 48787**; **POLAND:** on *Betula*, undated, B. Eichler 63, (lectotype of *Sebacina podlachica*) **S**; **TAHITI:** PIRAE DIST.: trail to Cascades, on dead limb of *Hibiscus tiliaceus*, 8 Apr. 1956, L.S. Olive T120, (holotype of *Sebacina gloeofilum*) **NY**.

Selected additional specimens examined: **CHANNEL ISLANDS:** GUERNSEY: Fermain Bay, on rotten fallen wood, 8 Nov. 1993, P.J. Roberts 753, **K(M) 30630**; JERSEY: St Peter's Valley, on fallen wood, 13 Nov. 1993, P.J. Roberts 780, **K(M) 30631**; SARK: Dixcart Valley, on fallen wood, 6 Nov. 1993, P.J. Roberts 738, **K(M) 30629**; **ENGLAND**: CAMBRIDGESHIRE: Cambridge, on wood, 12 Feb. 1925, E.J.H. Corner (as *Sebacina fugacissima*?), **K(M) 48308**; DEVON: near Sidmouth, on dead *Corylus* branch, 28 Jan. 1983, J. Webster, (as *Myxarium* cf. *laccatum*) **K(M) 48561**; Ipplepen, Orley Common, on fallen *Prunus spinosa* branch, 24 Feb. 1991, P.J. Roberts 147, **K(M) 30623**; same location, on rotten deciduous wood, 11 Jan. 1992, P.J. Roberts 361, **K(M) 30627**; Slapton, France Wood, on rotten fallen branch, 4 May 1994, P.J. Roberts 866, **K(M) 30637**; HUNTINGDONSHIRE: Houghton, near Hemmingford Grey, on *Tilia*, 15 Mar. 1970, D.A. Reid (as *Sebacina mesomorpha* var. = *Myxarium laccatum*), **K(M) 48562**; NORFOLK: Wheatfen Broad, on dead stems of *Epilobium hirsutum*, 25 May 1947, R.W.G. Dennis, **K(M) 48462**; OXFORDSHIRE: Woodstock, Blenheim Park, on wood, 9 Oct. 1973, R.W.G. Dennis, (as *Sebacina fugacissima*) **K(M) 48388**; SHROPSHIRE: Ludlow, Haye Park, on wood, Sep. 1937, E.M. Wakefield, (as *Sebacina fugacissima*) **K(M) 48385**; SURREY: Englefield Green, Cooper's Hill, on very rotten *Ulmus*, 31 Oct. 1988, N.W. Legon, (as *Myxarium podlachicum*) **K(M) 12**; WEST SUSSEX: Amberley Wild Brooks, on *Quercus*, 1 Apr. 1970, D.A. Reid, (as *Sebacina podlachica*) **K(M) 48395**; YORKSHIRE: Pickering, Howldale, on *Quercus*, 1 Nov. 1972, W.G. Bramley K/72/19, (as *Sebacina podlachica*) **K(M) 48396**; **SCOTLAND:** ARGYLLSHIRE: Isle of Ulva, on *Fagus*, 17 Apr. 1969, R.W.G. Dennis, (as *Sebacina fugacissima* f. *sebacea*) **K(M) 48389**; INVERNESS-SHIRE: Isle of Raasay, Clachen, on fallen branches of *Tilia*, 7 Sep. 1976, R.W.G. Dennis, (as *Myxarium podlachicum*) **K(M) 48394**; ORKNEY ISLANDS: Hoy, Berriedale, on *Betula*, 9 Sep. 1988, R.W.G. Dennis, **K(M) 549**.

CAMEROON: S.W. PROVINCE: Korup National Park, on very rotten log, P.J. Roberts, 3 Apr. 1997, **K(M) 50171**; **CUBA:** Cienfuegos, near Central Soledad, on *Pithecolobium samon* log, 8 Jul. 1941, W.L. White (Reliq. Farlow. 994, as *Sebacina podlachica*), **K(M) 49371**; **FRANCE:** Allier, St Priest, on *Populus*, 2 May 1905, H. Bourdot 14013, (as *Sebacina podlachica*) **K(M) 47465**; same location, on *Quercus*, 2 Nov. 1907, H. Bourdot 9162, (as

Sebacina fugacissima f. *subtypica*) **PC**; **GERMANY**: Coburg, Rodertal bei Weidhausen, 2 Feb. 1975, H. Engel, (as *Myxarium podlachicum*) **K(M) 47463**; **NETHERLANDS**: LIMBURG: Bunderbos, on fallen wood, 8 Sep. 1995, P.J. Roberts, **K(M) 30858**; **NORWAY**: AKERSHUS: Eidsvoll, Kirke, on fallen wood, 16 Sep. 1993, P.J. Roberts 674, **K(M) 30633**; Oslo, Maridalen, Vaggetem, on old *Fomes fomentarius*, 8 Oct. 1994, L. Ryvarden 34590, **K(M) 49414**; **PANAMA**: CHIRIQUÍ PROV.: valley of upper Rio Chiriquí Viejo, overgrowing resupinate hydnoid fungus, 2 Jul. 1935, G.W. Martin 2334, (as *Stypella minor*) **K(M) 48067**; **POLAND**: on *Betula*, undated, B. Eichler 96, (as *Sebacina podlachica*) **K(M) 47426**; **SWITZERLAND**: Graubünden, on *Corylus*, 4 Sep. 1979, Å. Strid 16172, **S**; **USA**: IOWA: Johnson Co., Turkey Creek, on *Populus* bark, 28 Oct. 1933, D.P. Rogers 335, (as *Stypella minor*) **K(M) 48231**; MASSACHUSETTS: Canton, on decaying *Malus* log, 19 Apr. 1934, D.H. Linder (Reliq. Farlow. 787, as *Tremella grilletii*) **K(M) 48284**.

Stypella grilletii is difficult to recognize with confidence in the field, but can be identified microscopically by its lack of cystidia and by its variable ellipsoid to oblong basidiospores (Table 3). The sequence of growth from individual crystalline basidiomes to a single, smooth, effused, compound basidiome is based on a series of field observations, also observed and noted by Whelden (1934: 420). Intermediates occur at all stages, young individual basidiomes often being found at the edge of larger compound basidiomes. The coalescing basidiomes, presence of 4-celled as well as 2-celled basidia, and generally narrower spores separate *S. grilletii* from *S. crystallina*. The species is extemely common, at least in Britain, and the specimens cited above are just a fraction of those examined.

Current taxonomic texts recognize *Myxarium podlachicum* as a species distinct from *S. grilletii*, the former having a smooth, effused basidiome, the latter being pustular to tuberculate. Examination of the lectotype specimen of *M. podlachicum* (cited above) shows no other differences between these two taxa. Basidiospores measure 6.5 - 9 x 3.5 - 5 µm ('7 - 9 x 4 - 5µm', *fide* Bresadola's annotation), and are indistinguishable from those of *S. grilletii*. It appears therefore that *Myxarium podlachicum* is simply a name applied to older, effused basidiomes of *S. grilletii*, and it is accordingly here proposed as a synonym.

The selection of the lectotype of *M. podlachicum* presents some problems, since Bresadola sent out a number of different collections as 'types'. According to the original description (Bresadola, 1903), Eichler's type should be on *Betula*. As noted by Reid (1970), a collection at K marked 'typus' (K(M) 47423) is on *Populus*, whilst Burt (1915) noted that the 'type' at FH is on *Fagus*. Excluding these specimens, the two remaining candidate collections, both on *Betula*, appear to be Eichler 63 and Eichler 96. The former was forwarded by S as the 'type', and is here selected as the lectotype. As noted by Reid (1970), the collection at K on *Populus* (marked 'typus') has large spores and lacks myxarioid basidia. Re-examination shows that it also possesses gloeocystidia and is in fact *Basidiodendron cinereum* (Bres.) Luck-Allen.

Reid (1973) examined an authentic specimen of *Tremella glacialis*, and placed it in synonymy with *Tremella grilletii*, based on spore shape and size ('elliptical to broadly elliptical, 5.75 - 7.5 x (2.2 -) 3.0 - 3.75 µm'). Re-examination of this specimen, here selected as lectotype (cited above), confirms this synonymy. Bourdot & Galzin (1928) differentiated the species from *Tremella grilletii* on the basis of its smaller spores ('5 - 6 - 8 x 3 - 5 µm' for *T. glacialis*, '6 - 10 x 3 - 5 µm' for *T. grilletii*) and its non-coalescing basidiomes. Since spore length ranges of 5.5 - 12 µm have been obtained from a single spore print of *Stypella grilletii*, and the coalescence of basidiomes depends on age, the distinctions drawn by Bourdot & Galzin (1928) are unlikely to be valid.

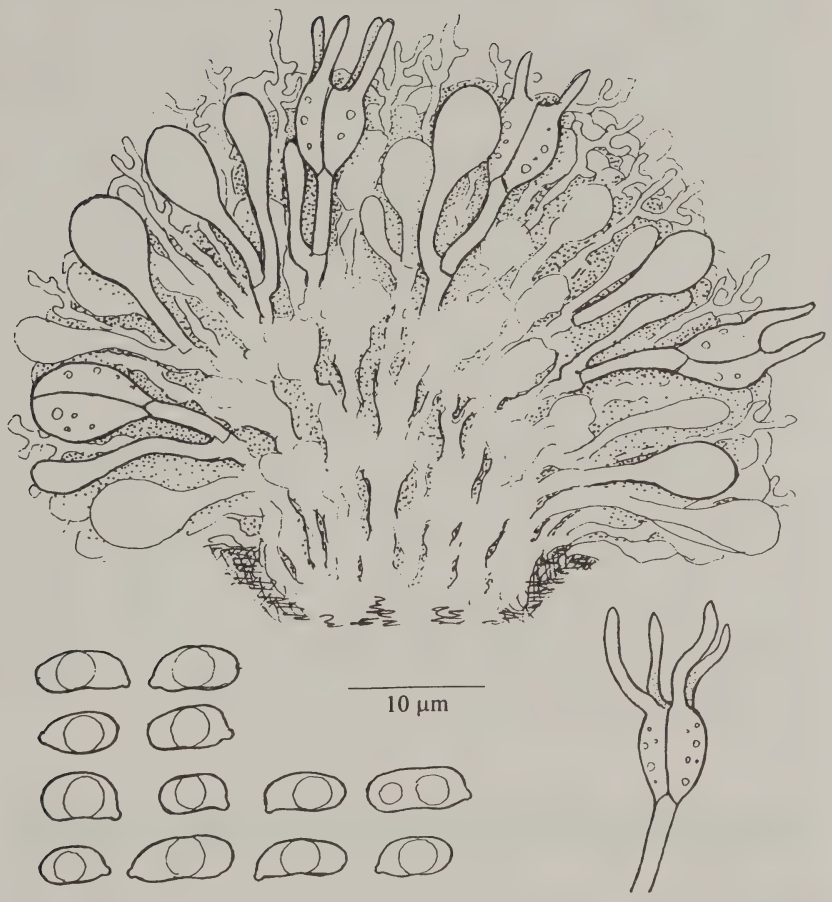


Fig. 7. ***Stypella grilletii***. Individual basidiome showing immature and 2-4 celled mature basidia; basidiospores; basidium, showing enucleate stalk (England, K(M) 30637).

Based on the redescription by Wells (1961), *Sebacina crozalsii* is a further synonym of *Stypella grilletii*, having myxarioid basidia 7 - 9 µm wide and basidiospores 7.5 - 11 x 3.5 - 5 µm. Wells himself proposed synonymy with *Sebacina podlachica*. Bourdot's syntypes of *Sebacina crozalsii,* studied by Wells, were not available for re-examination.

The species *Myxarium varium* was based on a single specimen which had some terminal and subterminal hymenial hyphae swollen up to 6 µm wide. The taxon is otherwise identical to *S. grilletii* and hardly seems distinct. It is here considered a synonym.

The holotype specimen of *Sebacina gloeofilum* (cited above) is wholly collapsed, but the spore range (6 - 8 x 3.5 - 4.5 µm) and overall appearance are indistinguishable from *S. grilletii* with which it is here also placed in synonymy. Olive (1958) originally distinguished the species as having hyphidia ('paraphyses') with faintly yellowish, granular contents, but did not compare it with *Stypella grilletii*. Wells (1961) suggested *Sebacina gloeofilum* was a synonym of *Sebacina podlachica* or *Sebacina sublilacina* Martin.

Dennis in Donk (1966, p. 318) suggested that *Tremella juniperina* P. Karst., 1869 (*nom. illeg.*; *non* L., 1753), might be *Stypella grilletii*. However, a re-examination of an isotype at K (FINLAND: Mustiala, on *Juniperus*, 8. Apr. 1869, P. Karsten (Fungi Fenn. Exs. 812), K(M) 56680) shows that *T. juniperina* is a genuine *Tremella* species similar to or conspecific with *T. globispora* D.A. Reid.

Reid (1970) assigned a collection from Huntingdonshire (cited above) to *Sebacina mesomorpha* Bourdot & Galzin as a variety of *Sebacina laccata* Bourdot & Galzin and, recognizing that it possessed myxarioid basidia, proposed the new combination *Myxarium laccatum* (Bourdot & Galzin) D.A. Reid to accommodate it. From the description plus a re-examination of the specimen, it seems clear that this new combination was based on a misdetermination of *S. grilletii* and that the original *Sebacina laccata* is a quite different and unrelated taxon (see below). *Myxarium laccatum sensu* Reid is thus an additional synonym of *S. grilletii*. With the exception of a specimen from Sidmouth, Devon (cited above), all other British material at K determined as *Myxarium laccatum*, *Sebacina laccata*, or *Sebacina mesomorpha* is *Exidiopsis effusa* (Bref. ex Sacc.) Möller.

Specimen	Spore range (µm)	Spore shape (Q)
S. podlachica (type)	6.5 - 9 x 3.5 - 5	1.55 - 2.8
S. gloeofilum (type)	6 - 7.5 x 4 - 4.5	1.5 - 1.9
Roberts 147	(5 -) 5.5 - 7 (- 8) x 3 - 3.5 (- 4)	1.6 - 1.9
Roberts 361	(4 -) 6.5 - 8.5 (- 9.5) x (3 -) 3.5 - 4 (- 5)	1.5 - 2.45
Roberts 674	5.5 - 9.5 (- 12) x 3 - 3.5 (- 5.5)	1.8 - 2.8
Roberts 780	4 - 6.5 (-8) x 2.5 - 3 (- 3.5)	1.75 - 2.3
Roberts 866	5 - 7 (- 8) x 2.5 - 3 (- 3.5)	1.75 - 2.4

Table 3. ***Stypella grilletii***. Range of size and shape in basidiospores from different collections. Type specimens measured from mounts, others from spore prints.



Fig. 8. ***Stypella grilletii***. Basidiospores (holotype of *Sebacina podlachica*, S).

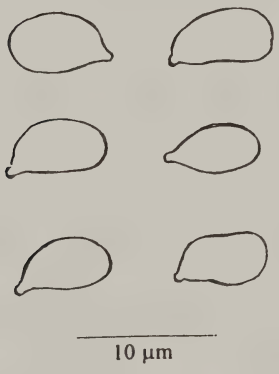


Fig. 9. ***Stypella grilletii***. Basidiospores (holotype of *Sebacina gloeofilum*, NY).

Stypella legonii P. Roberts **sp. nov.** **Figs. 10-11**

Protodontia ellipsospora D.A. Reid, *Mycol. Res.* 94: 104 (1990) [nom. inval.]

Stypella subgelatinosa similis, sed sporae oblongae vel cylindraceae (Q = 1.8 - 2.8), (3.5 -) 4 - 6.5 (- 9) x (2 -) 2.5 - 3 μm.

In trunco vetusto *Ulmi*, Anglia, Surrey, Cooper's Hill, 5 Mar. 1988, N.W. Legon, holotypus, K(M) 49367.

Basidiomes and microscopic characters (other than basidiospores) as *Stypella subgelatinosa* (below). *Basidiospores* narrower than in *S. subgelatinosa*, oblong to cylindrical (Q = 1.8 - 2.8), (3.5 -) 4 - 6.5 (- 9) x (2 -) 2.5 - 3 μm. *Habitat* on fallen, rotten deciduous wood. *Known distribution* England, United States.

Type specimen examined: **ENGLAND**: SURREY: Englefield Green, Cooper's Hill, inside a very old *Ulmus* trunk, 5 Mar. 1988, N.W. Legon, (holotype) **K(M) 49367**.

Selected additional specimens examined: **ENGLAND**: DEVON: Slapton Wood, on rotten, fallen, deciduous trunk, 5 Dec. 1992, P. J. Roberts 539, **K(M) 33175**; Slapton, Marsh Lane, on rotten, fallen, deciduous wood, 5 Feb. 1993, P.J. Roberts 616, **K(M) 33176**; Ipplepen, Orley Common, on rotten, fallen *Ulmus* branch, 19 Jun. 1993, P.J. Roberts 645, **K(M) 33177**; HERTFORDSHIRE: near Walkern, Box Wood, on rotten *Ulmus*? log, 2 Nov. 1994, K. Robinson, **K(M) 30735**; MIDDLESEX: Perivale Wood, on very rotten fallen *Ulmus*, 11 Dec. 1988, A. Henrici, **K(M) 1022**; SURREY: Weybridge, on very rotten wood, 16 Dec. 1917, A.A. Pearson, (as *Protodontia uda*) **K(M) 49361**; Englefield Green, Cooper's Hill, on very rotten, fallen *Ulmus* trunk, 29 Nov. 1987, N.W. Legon, (as *Protodontia subgelatinosa*) **K(M) 49364**; Norbury Park, on rotten *Ulmus* trunk, 3 Apr. 1989, N.W. Legon, **K(M) 5240**; same location, on rotten *Buxus*, 11 Dec. 1994, N.W. Legon, **K(M) 30143**; WEST SUSSEX: Madehurst, on very rotten, fallen *Fagus* trunk, 19 Feb. 1973, D.A. Reid, (as *Protodontia subgelatinosa*) **K(M) 49360**.

USA: IOWA: Iowa City, Linder's Woods, 5 Oct. 1932, D.P. Rogers 247 (as *Protodontia uda*), **K(M) 47297**.

Stypella legonii is similar to *S. subgelatinosa*, but has narrower, differently shaped basidiospores. In all collections examined, these are consistently oblong to cylindrical (Q = 1.8 - 2.8) whereas in *S. subgelatinosa* they are mainly subglobose to ellipsoid, with a few occasionally oblong (Q = 1.1 - 1.9).

Reid (1990) noted this distinction, and published the narrow-spored taxon as a new species, *Protodontia ellipsospora.* However, this name was invalidly published on a technicality (holotype herbarium not specified). Rather than validate the name 'ellipsospora' (which is rather misleading when transferred to *Stypella*), a new epithet has been chosen, acknowledging the collector, N.W. Legon.

Stypella subgelatinosa is reported on both deciduous and coniferous wood, whereas *S. legonii* is only known from deciduous wood. In both species, the preferred substratum appears to be soft, highly decayed wood. *S. legonii* is commoner in southern England than *S. subgelatinosa*, but its full range is not yet known. A North American specimen (cited above) has spores measuring 5 - 6.5 x 2.5 - 3 μm (Q = 2 - 2.2) and appears conspecific with the English collections.

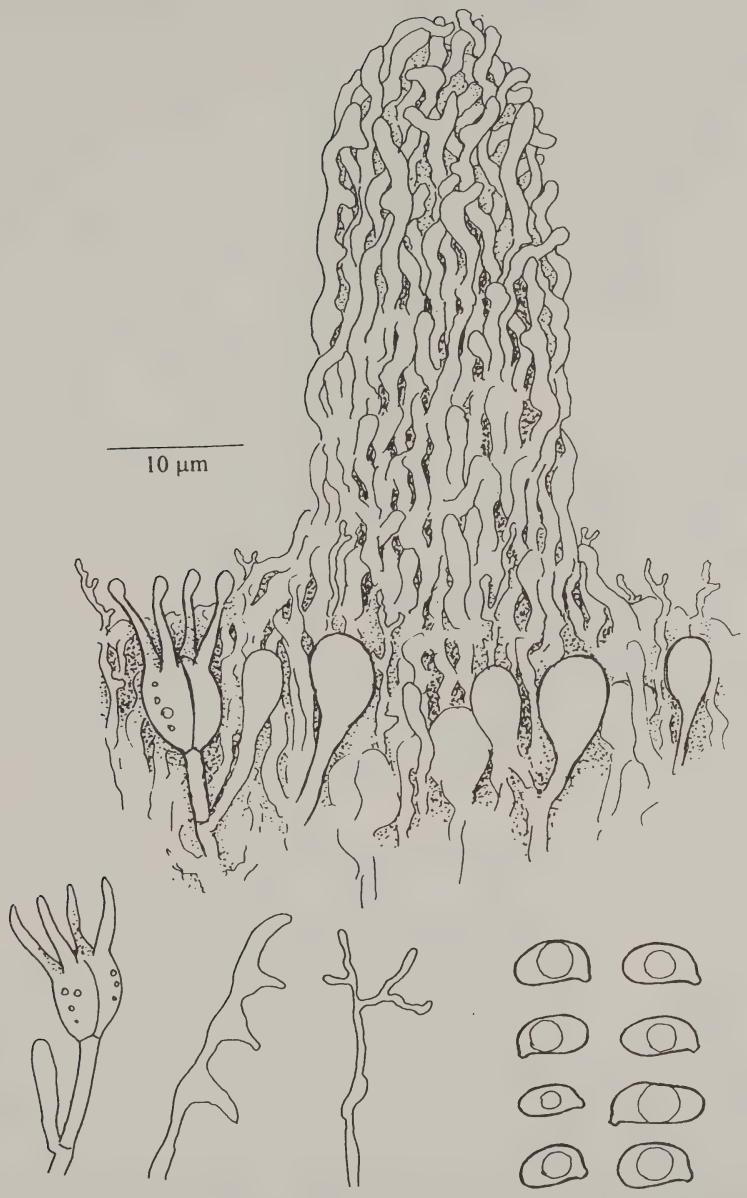


Fig. 10. ***Stypella legonii***. Section of hymenium from compound basidiome, showing prominent hyphal peg, immature and mature basidia; basidium, showing enucleate stalk; antler-like hyphidium from the hyphal peg; normal branching hyphidium from the hymenium; basidiospores (England, K(M) 33177).

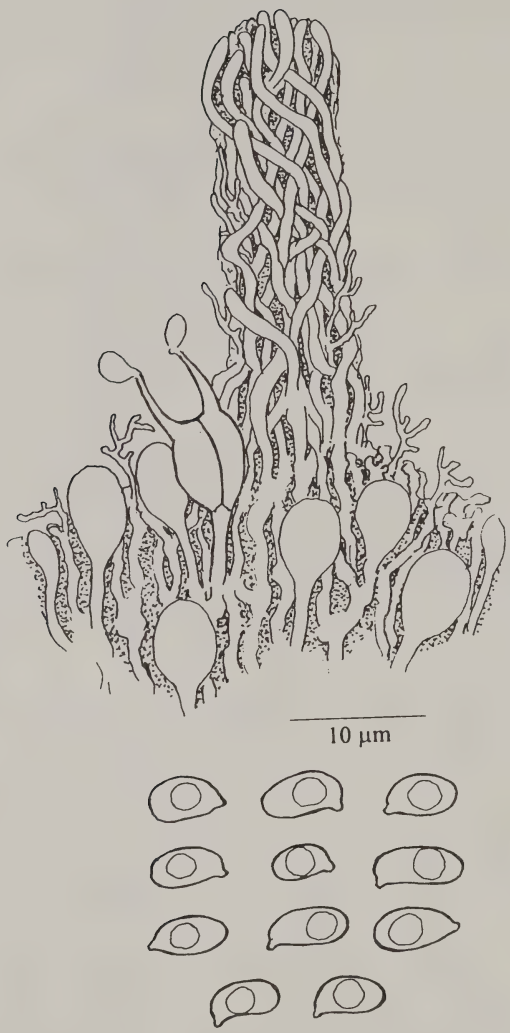


Fig. 11. ***Stypella legonii***. Section of hymenium from compound basidiome, showing prominent hyphal peg, immature and mature basidia; basidiospores (England, K(M) 33176).

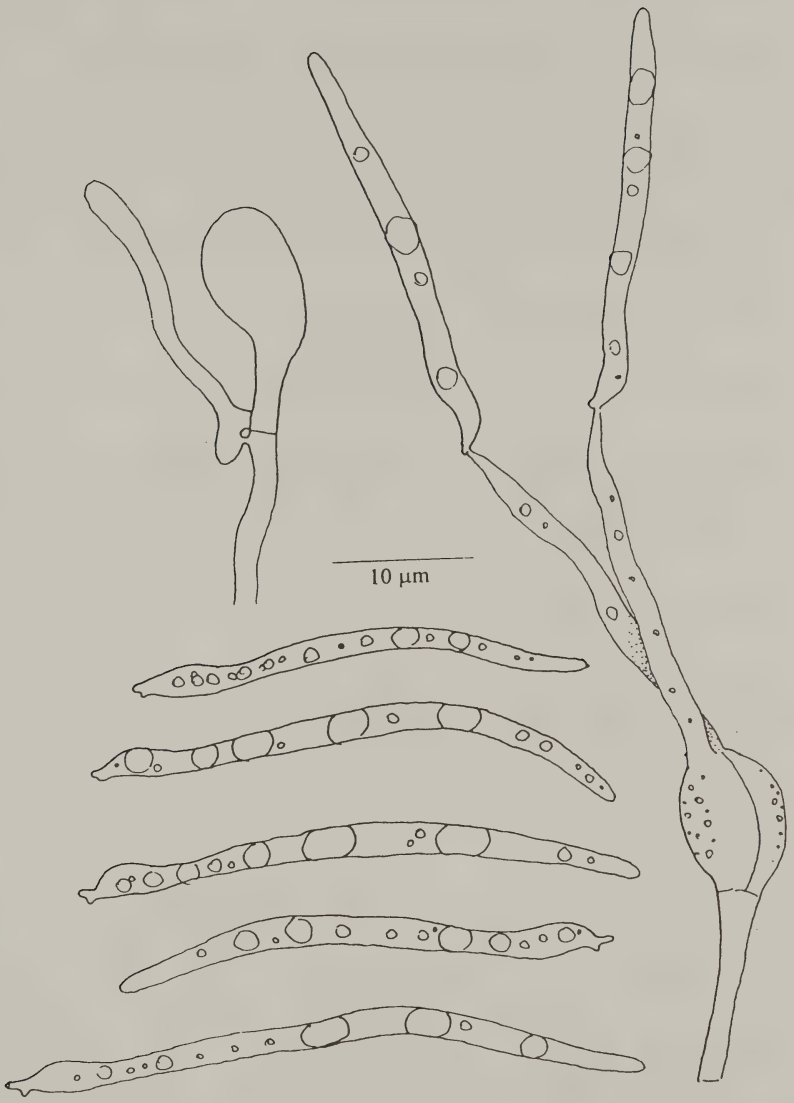


Fig. 12. ***Stypella mirabilis***. Young and mature basidia, the latter bisterigmate with two basidiospores attached; basidiospores (England, holotype, K(M) 33191).

Stypella mirabilis P. Roberts **sp. nov.** **Fig. 12**

Stypella grilletii similis, sed sporae elongatae, vermiformae, 26 - 48 x 2 - 2.5 µm.

Ad caules *Rubi idaei*, Anglia, Devon, Torquay, Scadson Woods, 29 Dec. 1994, P.J. Roberts 899, K(M) 33191, holotypus.

Basidiomes similar to those of *S. grilletii*, coalescing with age. *Hyphae* & *hyphidia* similar to those of *S. grilletii*. *Cystidia* absent. *Basidia* similar to those of *S. grilletii*, but 2-celled in specimens examined. *Basidiospores* elongated, vermiform, 26 - 48 x 2 - 2.5 µm from print of holotype, producing secondary spores, presumably germinating by germ tube. *Habitat* so far known only from dead stems of *Rubus idaeus*. *Known distribution* England.

Type specimen: **ENGLAND**: DEVON: Torquay, Scadson Woods, on dead standing stems of *Rubus idaeus*, 29 Dec. 1994, P.J. Roberts 899, (holotype) **K(M) 33191**.

Additional specimen examined: same location and substratum, 21 Jan. 1996, P.J. Roberts, **K(M) 33705**.

Given the rather limited range of globose to oblong basidiospores found in other *Stypella* species, a collection with vermiform spores was a considerable surprise and still remains so. Clearly it must be a rare species (at least in Europe) for it to have been overlooked until now.

Stypella subgelatinosa (P. Karst.) P. Roberts **comb. nov.**

Figs. 13-14

Hydnum subgelatinosum P. Karst., *Medd. Soc. Fauna Flora Fenn.* 9: 50 (1882)
Protohydnum lividum Bres., *Annls Mycol.* 1: 117 (1903)
Protodontia uda Höhn., *Sber. Akad. Wiss. Wien (Math.-Nat.)* 116: 83 (1907)
Protohydnum subgelatinosum (P. Karst.) S. Lundell, Fungi Exs. Suec.29-30: 21 (1947)
Protodontia subgelatinosa (P. Karst.) Pilát, *Sb. Nar. Mus. Praze* 13: 200 (1957)
Stypella parvula Hauerslev, *Mycotaxon* 49: 231 (1993)

Basidiomes arising as individual basidiomes, then coalescing to form effused compound basidiomes; each individual basidiome develops an apical tuft or peg of sterile hyphae giving the compound basidiome an odontioid appearance; hyphal pegs projecting 50 - 500 µm above the hymenial surface. *Hyphae* and *hyphidia* similar to those of *S. grilletii*; hyphae in pegs are normally weakly branched towards the apex, hyphidia-like, closely or loosely intertwined in a gelatinous matrix. *Cystidia* absent. *Basidia* similar to those of *S. grilletii*. *Basidiospores* subglobose to ellipsoid, a few occasionally oblong (Q = 1.1 - 1.9), 4 - 7.5 x 3.5 - 5 (- 5.5) µm from prints, frequently producing secondary spores, germinating by germ tube. *Habitat* on fallen deciduous and conifer wood. *Known distribution* Europe.

Type specimen examined: **DENMARK**: Kongelunden, on rotten wood, 12 Oct. 1980, K. Hauerslev 5920, (holotype of *Stypella parvula*) **C 19755**.

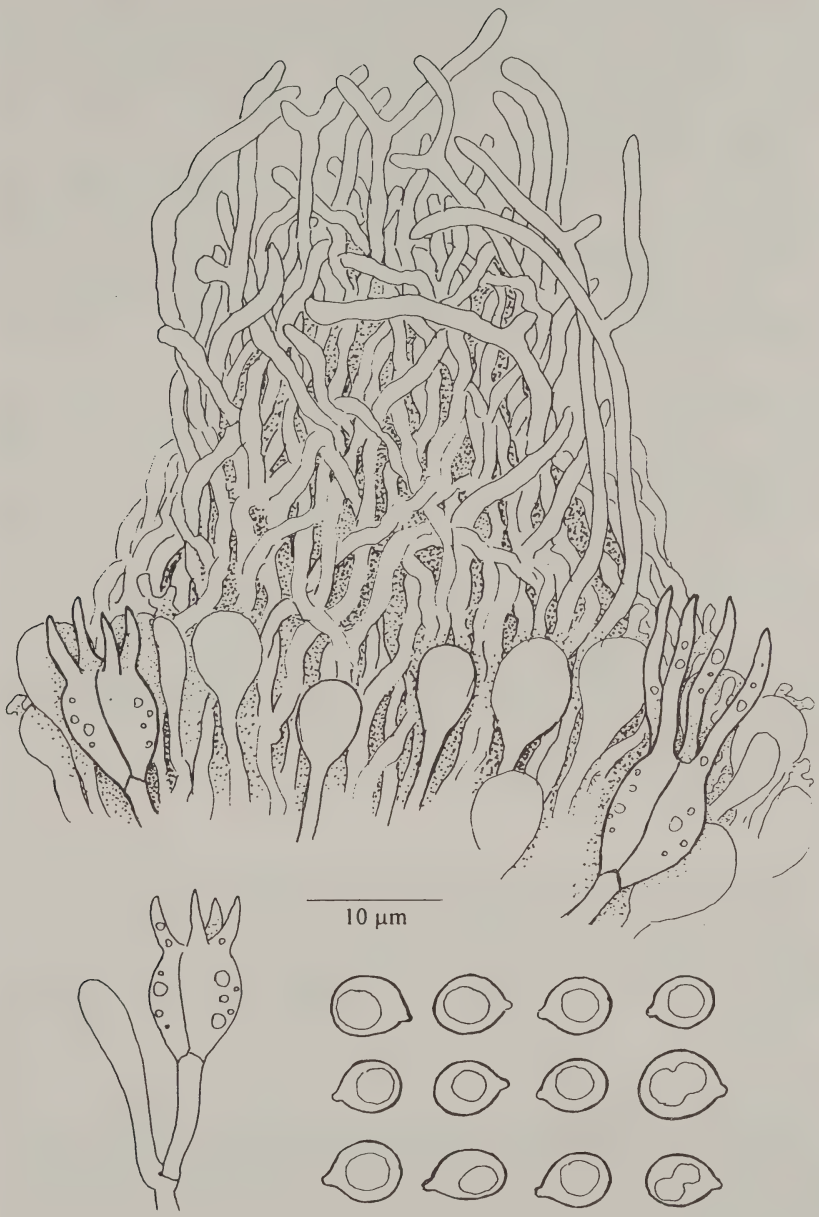


Fig. 13. ***Stypella subgelatinosa***. Section of hymenium from compound basidiome, showing hyphal peg, immature and mature basidia; mature basidium, showing enucleate stalk; basidiospores (Norway, K(M) 33174).

Additional specimens examined: **ENGLAND:** DEVON: Bovey Tracey, Great Plantation, on rotten *Betula*? log, 19 Mar. 1989, P.J. Roberts 93, **K(M) 18788**; EAST SUFFOLK: Fritton Lake, on rotten wood, 29 May 1937, A.A. Pearson, (as *Protodontia lividum*) **K(M) 49358**; same details, (as *Protodontia uda*) **K(M) 49357**; KENT: Lullingstone Park, on rotten *Ulmus* logs, 14 Nov. 1993, A. Henrici, **K(M) 25037**; SURREY: Norbury Park, on very old *Fagus* stump, 13 Mar. 1988, N.W. Legon, (as *Protodontia uda*) **K(M) 49359**; Mickleham Downs, on old *Larix*? log, 7 Jun. 1994, A. Henrici, **K(M) 27128**.

FRANCE: AVEYRON: St Sernin, Balagnier, on *Alnus*, Jul. 1905, A. Galzin 1054 (H. Bourdot 4572) (as *Protohydnum lividum*) **K(M) 47321** & **K(M) 47323**; L'Hôpital, on *Fagus*, 5 Dec. 1915, A. Galzin 18957 (H. Bourdot 18040) (as *Protohydnum lividum*) **K(M) 47322**; **NORWAY:** AKERSHUS: Nannestad, Tømte, on *Betula* log, 18 Sep. 1993, P.J. Roberts 688, **K(M) 33174**; NORDLAND: Junkerdalsura-Storjord, Saltdal, on *Alnus incana*, 26 Aug. 1988, L. Ryvarden 25501, **K(M) 715**; **SWEDEN:** DALSLAND: Edsleskog parish, Klöverud, on ?*Picea* stump, 12 Sep. 1990, T. Læssøe 3048, (as *Protodontia piceicola*) **K(M) 15492**; VÄSTERGÖTLAND: Göteborg, St. Änggärden, Naturparken, on fallen trunk of *Alnus glutinosa*, 2 Sep. 1942, T. Nathorst-Windahl 3235 (Fungi Exs. Suec.1433, as *Protohydnum subgelatinosum*) **K(M) 47394**.

Stypella subgelatinosa can be recognized by its prominent pegs of sterile hyphae and subglobose to ellipsoid basidiospores. The size and appearance of the hyphal pegs vary considerably from collection to collection, the changes presumably related to basidiome age.

Reid (1990) re-examined type specimens of *P. subgelatinosa*, *Protodontia uda*, and *Protohydnum lividum*, illustrated their basidiospores, and concluded that they were conspecific, a view shared here.

Hauerslev (1993) described *Stypella parvula* without reference to *S. subgelatinosa*, though his new species differed only in possessing two-celled basidia and slightly larger basidiospores. Re-examination of the type specimen (cited above) showed spores typical of *S. subgelatinosa* (no larger), together with two-celled basidia (though few mature basidia were seen). It is possible that *S. parvula*, known only from a single collection, represents a distinct, bisterigmate taxon rather than just an atypical specimen. But for the moment, it is considered a synonym of *S. subgelatinosa*.

Stypella legonii differs from *S. subgelatinosa* in having narrower, oblong basidiospores, as noted above.

Stypella subhyalina (Pearson) P. Roberts **comb. nov.** **Fig. 15**

Sebacina subhyalina A. Pearson, *Trans. Brit. Myc. Soc.* 13: 71 (1928)
Sebacina sublilacina G.W. Martin, *Mycologia* 26: 262 (1934)
Exidiopsis sublilacina (G.W. Martin) Ervin, *Mycologia* 49: 123 (1957)
Myxarium sublilacinum (G.W. Martin) Raitv., Opr. Getero. Grib. SSSR: 66 (1967)
Myxarium subhyalinum (A. Pearson) D.A. Reid, *Trans. Brit. Myc. Soc.* 55: 426 (1970)
Myxarium vernicosum Hauerslev, *Mycotaxon* 49: 253 (1993)

Basidiomes arising as individual basidiomes, but rapidly expanding laterally to form a smooth, effused, compound basidiome, typically bluish grey, with small but visible white mineral inclusions. *Hyphae* and *hyphidia* similar to *S. grilletii*. *Cystidia* sparse, thin-walled, hyaline, acute, swollen towards the base, up to 60 µm long, typically projecting from the hymenium for approximately half their length. *Basidia* similar to those of *S. grilletii*. *Basidiospores* ellipsoid to cylindrical (Q = 1.3 - 2.4),

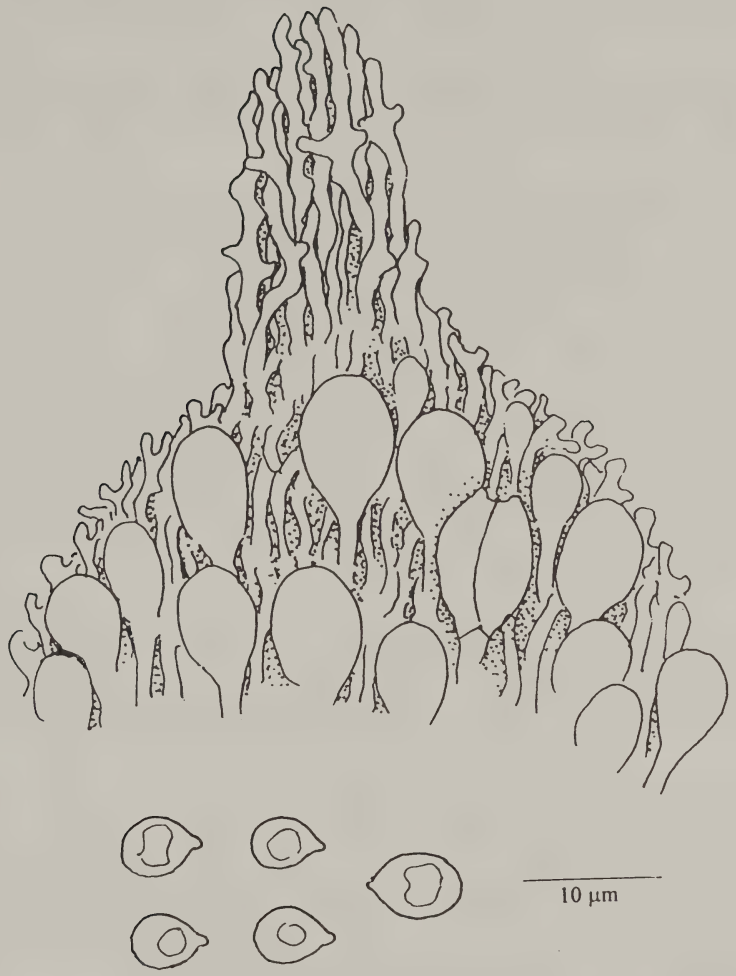


Fig. 14. ***Stypella subgelatinosa***. Section of hymenium from compound basidiome, showing hyphal peg, immature and mature basidia; basidiospores (Denmark, holotype of *Stypella parvula*, C 19755)

some often constricted or weakly depressed, (5 -) 6 - 8.5 (- 10) x (2.5 -) 3 - 4 µm from prints, frequently producing secondary spores, germinating by germ tube. *Habitat* on fallen deciduous wood, occasionally on old polypore basidiomes. *Known distribution* Europe, North America.

Type specimen examined: **DENMARK**: Falster, Korselitse Skov, on wood, 16 Sep. 1980, K. Hauerslev 6089, (holotype of *Myxarium vernicosum*) **C 19747**; **ENGLAND**: EAST SUSSEX: Buckhurst Wood, on much decayed *Fagus* wood, 30 Oct. 1926, A.A. Pearson, (lectotype of *Sebacina subhyalina*) **K(M) 48327**.

Selected additional specimens examined: **CHANNEL ISLANDS**: SARK: Dixcart Valley, on fallen *Fraxinus*? wood, 6 Nov. 1993, P.J. Roberts 737, **K(M) 33182**; **EIRE**: KERRY: Killarney, Ross Island, on wood, 20 Sep. 1936, A.A. Pearson, (as *Sebacina grisea*) **K(M) 48329**; Killarney, on wood, Aug. 1946, R.W.G. Dennis, (as *Sebacina sublilacina*) **K(M) 48326**; **ENGLAND**: BEDFORDSHIRE: Wilmstead Wood, on wood, 30 Oct. 1977, D.A. Reid & A. Thomas, **K(M) 48324**; CAMBRIDGESHIRE: Cambridge, Madeley Wood, undated, A.F.R. Parker-Rhodes (as *Sebacina fugacissima*), **K(M) 48319**; DEVON: Ipplepen, Orley Common, on fallen *Hedera* wood, 23 Feb. 1991, P.J. Roberts 190, **K(M) 16951**; same location, on fallen *Prunus spinosa*? wood, 5 Feb. 1994, P.J. Roberts 832, **K(M) 33183**; HAMPSHIRE: New Forest, Denny Wood, on wet *Fagus* wood, 27 Oct. 1990, T. Læssøe 2258, **K(M) 16243**; SURREY: Richmond Park, on rotten *Quercus* branch, 3 May 1933, E.M. Wakefield, **K(M) 48328**; Esher, West End Common, on fallen *Betula* branch, 6 Jul. 1997, P.J. Roberts, **K(M) 52681**; WARWICKSHIRE: Oversley Wood, on *Betula* bark, Feb. 1975, R.E. Evans 1379, **K(M) 48323**; WEST SUSSEX: Arundel, Swanbourne Lake, on *Fraxinus*?, 4 Mar. 1973, D.A. Reid, **K(M) 48322**; YORKSHIRE: Pickering, on old *Ganoderma* basidiome on *Fraxinus*, 30 Mar. 1969, W.G. Bramley K/69/3, (as *Sebacina fugacissima*) **K(M) 48387**; **SCOTLAND**: LANARKSHIRE: Glasgow, Bearsden, on *Fagus*, 13 Sep. 1962, D.A. Reid, (as *Sebacina sublilacina*) **K(M) 48325**.

CANARY ISLANDS: TENERIFE: Las Mercedes, on decayed *Laurus azorica*? wood, 16 Jan. 1990, P.J. Roberts 61, **K(M) 18803**; **FRANCE**: NORMANDY: Igé, 16 Sep. 1952, on wood, E.M. Wakefield, (as *Exidiopsis fugacissima*) **K(M) 48245** & **K(M) 48279**; **NETHERLANDS**: LIMBURG: Sint Jansbosch, on fallen wood, 9 Sep. 1995, T. Læssøe, **K(M) 30799**; **NORWAY**: AKERSHUS: Eidsvoll, Kirke, on fallen wood, 16 Sep. 1993, L. Ryvarden, **K(M) 33190**; **USA**: IOWA: Iowa City, 3 May 1932, D.P. Rogers, (as *Sebacina podlachica*) **K(M) 49370**; same location, on wood, 26 Sep. 1934, G.W. Martin, (as *Sebacina sublilacina*) **K(M) 56838**; same location, on wood, 16 Apr. 1935, G.W. Martin, (as *Sebacina sublilacina*) **K(M) 48655**.

Stypella subhyalina is a common species in the British Isles, normally distinguishable in the field by its smooth, effused basidiome with small but visible mineral inclusions. For some time, no specimen could be found to prove that the species arises from individual basidiomes, but eventually one collection was made of a tuberculate basidiome with young individual basidiomes still present at its periphery (Fig. 8). It seems that initial growth is almost entirely lateral in these young basidiomes, leading to the rapid formation of smooth, compound basidiomes. Cystidia are sparse, but are always present if searched for. Together with the mineral inclusions, they are diagnostic for the species.

Pearson (1928) did not notice the presence of cystidia in his new species and differentiated it 'with much hesitation' from other 'muco-gelatinous Sebacinae'. Reid (1970) provided a full redescription, noted the cystidia and myxarioid basidia, and selected the lectotype (cited above). As noted by Reid (1970), *Sebacina sublilacina*, described from the USA, appears to be a synonym of *Stypella subhyalina*. The type description and accompanying illustrations, plus re-examination of two authentic collections at K (cited above), support this synonymy.

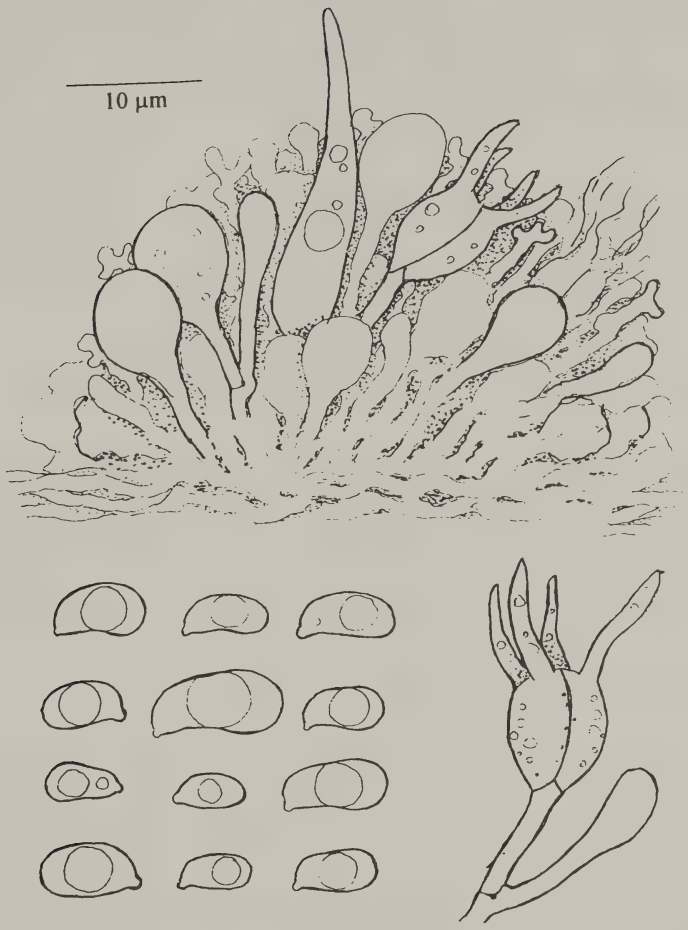


Fig. 15. ***Stypella subhyalina***. Individual basidiome, showing subulate cystidium, immature and mature basidia; basidiospores; mature basidium, showing enucleate stalk (England, K(M) 33183).

Myxarium vernicosum was distinguished from other *Myxarium* species by having ventricose to cylindrical cystidia up to '40 x 15 µm' (Hauerslev, 1993). A re-examination of the type specimen (cited above) suggests that it represents *S. subhyalina* with atypical, irregularly swollen, cystidia-like, basidia-like, and hyphidia-like elements just below the surface, possibly the remains of an aborted hymenium. The basidiome is smooth, effused, with white mineral inclusions, typical of *S. subhyalina*. The basidiospores of the type collection measure 6 - 8 x 3 - 4 µm and are indistinguishable from those of *S. subhyalina*. *Myxarium vernicosum* is accordingly proposed as a synonym of this species.

Stypella vermiformis (Berk. & Broome) D.A. Reid, *Trans. Brit. Myc. Soc.* 62: 473 (1974) **Fig. 16**

Dacrymyces vermiformis Berk. & Broome, *Ann. Mag. Nat. Hist.* V 1:25 (1879)
Stypella papillata Möller, Bot. Mitth. Trop. 8: 166 (1895)
Sebacina papillata (Möller) Pat., Essai Tax. Hym.: 25 (1900)
Sebacina crystallina Bourdot, *Trans. Brit. Myc. Soc.* 7: 53 (1921)
Heterochaetella crystallina (Bourdot) Bourdot & Galzin, Hymén. de France: 52 (1928)

Basidiomes similar to those of *Stypella crystallina,* individual basidiomes remaining discrete with age. *Hyphae* & *hyphidia* similar to *S. crystallina. Cystidia* conspicuous, tubular, sinuous, up to 150 x 8 µm, thin-walled, several arising from each individual basidiome, mostly enclosed and not or only slightly projecting above the hymenial surface. Basidia 2-4 celled, otherwise similar to *S. crystallina*. *Basidiospores* globose to subglobose (Q = 1.05 - 1.2), 3.5 - 5.5 x 3 - 5 µm from prints, frequently producing secondary spores, germinating by germ tube. *Habitat* on fallen conifer wood. *Known distribution* Europe, North & South America.

Type specimen examined: **ENGLAND**: SOMERSET: Bathford Plantation, on wood, I Apr. 1877, C.E. Broome 404, (holotype of *Dacrymyces vermiformis*) **K(M) 47312**.

Selected additional specimens examined: **ENGLAND**: BERKSHIRE: Windsor Forest, near The Lookout, on fallen *Pinus*, 26 Oct. 1996, P.J. Roberts, **K(M) 41485**; DEVON: Slapton Wood, on *Pinus* log, 3 Nov. 1992, P.J. Roberts 504, **K(M) 26062**; Dartmoor, Fernworthy Forest, on *Picea* log, 13 Jun. 1993, P.J. Roberts 581, **K(M)26055**; HAMPSHIRE: New Forest, Millyford Bridge, on fallen conifer wood, 13 Sep. 1992, P.J. Roberts, **K(M) 28812**; NORFOLK: near Holt, on fallen *Pinus* branch, 5 Jul. 1969, D.A. Reid, (as *H. crystallina*) **K(M) 47303**; NOTTINGHAMSHIRE: E., of Cuckney, Lord Woodstock's Plantation, The Dukeries, on *Taxus*, 25 Mar. 1962, R.W.G. Dennis, (as *H. crystallina*) **K(M) 47311**; SOMERSET: Batheaston, on wood, Apr. 1877, (ex herb. M.J. Berkeley), **K(M) 48724**; SURREY: Horsley, on wood, 11 Mar. 1922, A.A. Pearson, **K(M) 47310**; Mickleham Downs, on fallen *Larix* branch, 27 Feb. 1994, A. Henrici, **K(M) 33202**; WEST SUSSEX: Bignor Park, on fallen *Pinus* branch, 17 Apr. 1971, D.A. Reid, (as *H. crystallina*) **K(M) 47305**; **ISLE OF MAN**: Tholt-y-Will Glen, on fallen *Larix* branch, 7 Apr. 1994, A. Henrici, **K(M) 32368**; **NORTHERN IRELAND**: DOWN: Hillsborough, on wood, 11 Sep. 1931, E.M. Wakefield, (as *H. crystallina*) **K(M) 47309**; **SCOTLAND**: ARGYLLSHIRE: Isle of Mull, Glen Aros, on conifer log, 18 Apr. 1969, R.W.G. Dennis, (as *H. crystallina*) **K(M) 47306**; **WALES**: DYFED: Pembrey Country Park, on *Pinus* log, 21 Sep. 1994, P.J. Roberts, **K(M) 28022**.

AZORES: PICO: road to Gramminhais, on rotten *Clethra* branch, 24 Apr. 1995, B.M. Spooner & G. Butterfill AZ114, **K(M) 29541**; **CANADA**: ONTARIO: Parry Sound Dist., Pointe au Baril, on *Pinus strobus*, 15 Sep. 1972, R.F. Cain, **K(M) 38930**; **DENMARK**: S. JUTLAND: E. of Sønderborg, Als Sønderskov, on rotten *Picea* wood, 19 Sep. 1991, T. Læssøe, **K(M) 17942**;

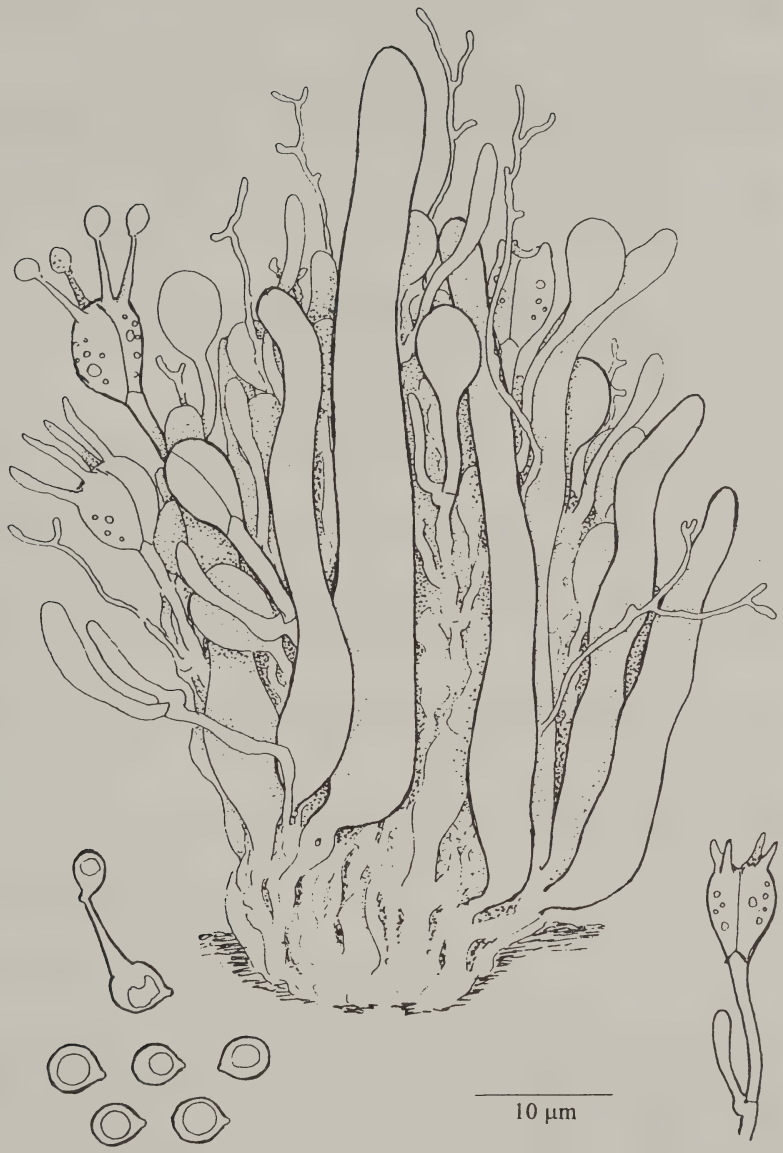


Fig. 16. ***Stypella vermiformis***. Individual basidiome, showing conspicuous cystidia, immature and mature basidia; basidiospores, one self-replicating; mature basidium, showing enucleate stalk (England, K(M) 26055).

USA: MASSACHUSETTS: Springfield, on *Pinus strobus* log, 16 Aug. 1943, A.M. & D.P. Rogers, **K(M) 38929**; TENNESSEE: Cades Cove, on wood, 11 Aug. 1968, D.P. Rogers, **K(M) 38931**.

Stypella vermiformis is easily recognized by its conspicuous, enclosed, thin-walled cystidia, subglobose spores, and habitat restricted to coniferous wood, at least in north temperate regions. Substrata include *Pinus*, *Picea*, *Larix*, and *Taxus* (also *Abies* and *Juniperus*, *fide* Reid, 1990). A specimen from the Azores (cited above) is on the non-coniferous shrub, *Clethra*. The species is common in Britain and the specimens cited above are just a small proportion of those examined. Reid (1974) provided details of synonymy.

Key to *Stypella* species

1. Cystidia present (inconspicuous in *S. subhyalina*).....2
1. Cystidia absent.....4

2. Cystidia thick-walled.....***Stypella dubia***
2. Cystidia thin-walled.....3

3. Cystidia conspicuous, abundant, apically obtuse; spores globose to subglobose; on conifers (at least in Europe); compound basidiome (under lens) composed of discrete gelatinous granules.....***Stypella vermiformis***
3. Cystidia inconspicuous, often sparse, apically acute; spores ellipsoid to oblong; on deciduous wood; individual basidiomes quickly coalescing; compound basidiome normally smooth, often with visible, white, mineral inclusions....***Stypella subhyalina***

4. Spores vermiform, 25 - 48 µm long.....***Stypella mirabilis***
4. Spores globose to cylindrical, under 12 µm long.....5

5. Forming a distinctly hydnoid compound basidiome.....6
5. Either forming a smooth or tuberculate compound basidiome, or composed of discrete gelatinous granules.....7

6. Most spores subglobose to ellipsoid (Q = 1.1 - 1.9), 3.5 - 5.5 µm wide.....***Stypella subgelatinosa***
6. Most spores oblong to cylindrical (Q = 1.8 - 2.8), 2 - 3 µm wide.....***Stypella legonii***

7. Basidia consistently 2-celled; most spores subglobose to ellipsoid, a few occasionally oblong (Q = 1.05 - 2.2); compound basidiome composed of discrete gelatinous granules.....***Stypella crystallina***
7. Most basidia 4-celled; spores subglobose to cylindrical (Q = 1.05 - 3.2); either forming a smooth or tuberculate compound basidiome, or composed of discrete gelatinous granules.....8

8. Spores subglobose to ellipsoid (Q = 1.05 - 1.45); on deciduous or coniferous wood.....***Stypella glaira***
8. Spores oblong to cylindrical (Q = 1.6 - 3.2); on deciduous wood.....***Stypella grilletii***

Dubious and excluded species

(listed alphabetically by epithet)

Hydnum anomalum Berk.& Broome, *Ann. Mag. Nat. Hist.* 15: 31 (1875)

Odontia anomala (Berk. & Broome) Rea, Brit. Basidiom.: 645 (1922)

Type specimen examined: **ENGLAND:** SOMERSET: Langridge, on rotten *Fraxinus*, 7 Mar. 1872, C.E. Broome 389, (lectotype) **K(M) 38640.**

Additional specimens examined: **ENGLAND:** SOMERSET: Langridge, on wood, 12 Mar. 1872, 389 (ex herb. C.E. Broome), **K(M) 49318**; same location and date, C.E. Broome (ex herb. C.B. Plowright), **K(M) 49319**; St Catherines, on wood, Mar. 1874, 389 (ex herb. C.E. Broome), **K(M) 38644.**

The lectotype collection of *Hydnum anomalum* (selected here and cited above) is a stypelloid species, but is in poor condition, so that little can be seen other than a collapsed basidiome with sparse reticulate-spiny projections, a wholly gelatinized context, faint outlines of what are probably basidia, and reasonably well-preserved basidiospores. These spores are subglobose to ellipsoid (Q = 1.1 - 1.5), 5.5 - 7.5 x 4 - 6 µm, suggesting that *H. anomalum* may be conspecific with *Stypella subgelatinosa,* or possibly *S. glaira,* or even *S. crystallina.* Given this uncertainty, it is not proposed to resurrect the name. Three additional authentic specimens of *Hydnum anomalum* (cited above) are similar, but equally collapsed.

Myxarium cinnamomescens (Raitv.) Raitv., in Parmasto, Zhivaya Priroda Dal'nego Vostoka: 113 (1971)

Exidia cinnamomescens Raitv., *Tartu Riikl. Ulik. Toim.* 136: 208 (1963)

No specimens have been examined of this little-known species, but the description suggests that it is conspecific with *Exidia nucleata*, which, like *M. cinnamomescens*, often becomes brown with age. There seems to be no other distinction between the taxa.

Tremella coriaria Bres., in Strasser, *Verh. Zool.-bot. Ges. Wien* 57: 300 (1907)

Type specimen examined: **AUSTRIA:** Sonntagberg, on old fragment of leather, 3 Nov. 1906, P.P. Strasser, (holotype) **S.**

Known only from the type specimen, *Tremella coriaria* was listed by Donk (1966) under 'Microtremella' together with a number of *Stypella* species, and briefly reviewed by Reid (1973) in relation to *Stypella crystallina*. Re-examination of the type shows that it is a young specimen of *Sebacina epigaea* (Berk. & Broome) Rea, having unclamped hyphae, basidia 12 - 15 µm wide, and ellipsoid spores measuring

10 - 12 x 6.5 - 7.5 µm (12 - 15 x 8 - 10 µm, according to Bresadola's annotation). *S. epigaea* has been collected on rotten rags in Britain, so its occurence on old leather is not too surprising.

Heterochaete cystidiophora (Lowy) P. Roberts **comb. nov.**

Heterochaetella cystidiophora Lowy, Flora Neotropica 6: 82 (1971)

Basidiomes effused, thin, *ca* 90 µm thick, densely covered with small, irregular hyphal pegs, salmon to buff with paler hypochnoid margin. *Hyphae* narrow in context, 1.5 - 2.5 µm wide, hyaline, thin-walled, with clamp connexions; slightly wider, 2 - 4 µm, in subhymenium. *Hyphidia* weakly branched and nodulose, antler-like. *Cystidia* (or encrusted hyphal ends) present and conspicuous in the hyphal pegs, appearing metuloid, fusiform, up to 12 µm wide, variably thick-walled, encrusted. *Basidia* 4-celled, non-myxarioid, 9.5 - 12.5 µm wide. *Basidiospores* allantoid, 12.5 - 15.5 x 6 - 7 µm from mount of holotype.

Type specimen examined: **BRAZIL**: EST. SANTA CATARINA: Morro de Bau, 22 Aug. 1965, B. Lowy 181 BR, (holotype) **LSUM SP 92404**.

This species bears no relationship to *Heterochaetella*, and Lowy (1971) offered no explanation for referring it to that genus. In fact it is typical of the genus *Heterochaete* Pat., except for the unusual and conspicuous encrusted hyphal ends in the hymenial pegs. An SEM illustration of these pegs was published by Lowy (1987).

Protohydnum fasciculare (Alb. & Schwein.: Fr.) Bres., *Annls Mycol.*18: 62 (1920)

Hydnum fasciculare Alb. & Schwein., Consp. Lusat. 269, t. 10, f. 9 (1805)
Protodontia fascicularis (Alb. & Schwein.: Fr.) Pilát ex Wojewoda, Grzyby VIII: 84 (1977)

As interpreted by Bresadola (1920), this taxon appears to be similar to *Protohydnum piceicola* Kühn. ex Bourdot (see below), having long, *Mucronella*-like spines and occuring on conifers. However, the spines were said to be fasciculate and the basidia large (12 - 13 µm wide). Donk (1966) doubted that *P. fasciculare* was a genuine *Protodontia* species. Its current disposition is uncertain, but it is here referred to *Protohydnum* Möller, *pro tem.*

Protodontia filicina Parmasto, *Bot. mat. Otd. spor. rast.* 15: 125 (1962)

Other than having been collected on ferns rather than wood, *Protodontia filicina* appears identical to *Protohydnum piceicola* (see below), to which it is referred *pro tem.*, pending a revision of the genus *Protohydnum*.

Microsebacina fugacissima (Bourdot & Galzin) P. Roberts, *Myc. Res.* 97: 473 (1993)

Sebacina fugacissima Bourdot & Galzin, *Bull. Soc. Myc. Fr.* 25: 28 (1909)

Exidiopsis fugacissima (Bourdot & Galzin) Sacc. & Trott. *Syll. Fung.* 21: 452 (1912)

Type specimen examined: **FRANCE:** AVEYRON: St Estève, on *Quercus*, 5 May 1915, A. Galzin 17914 (H. Bourdot 14916), (lectotype) **PC.**

Sebacina fugacissima has been variously interpreted. A cytological study of *S. fugacissima* by Whelden (1935) described a species with myxarioid basidia and acute cystidia, presumably *Stypella subhyalina*. Most specimens under the name *Sebacina fugacissima* at K are either *Stypella grilletii* or *S. subhyalina* (as cited under these names above). Authentic specimens from the Bourdot herbarium are equally diverse. A collection labelled 'f. subtypica' (unpublished) is *Stypella grilletii*. An additional specimen (Bourdot 5163, **PC**) labelled 'f. typica' is collapsed, but lacks clamp connexions and may possibly be the taxon now known as *Microsebacina microbasidia* (M.P. Christ. & Hauerslev) P. Roberts. A specimen labelled 'f. communis subspicata' (cited above) represents *Sebacina fugacissima* as interpreted by Wells (1961) and Roberts (1993), and is here selected as the lectotype of the species. *Microsebacina fugacissima* has small, non-myxarioid basidia and lacks hyphidia. It is not closely related to *Stypella*.

Stypella grandinia Rick ex Rambo, *Iheringia* 2: 31 (1958) [nom. inval.]

Said to be similar to *Stypella minor*, but with larger basidia and spores. It is unlikely to represent a genuine *Stypella* species. The name is invalidly published, since no type specimen was selected.

Myxarium hyalinum (Pers.) Donk, *Persoonia* 4: 233 (1966)

Tremella hyalina Pers., Myc. Eur. 1: 105 (1822)

Donk (1966) claimed that *Tremella hyalina* represented an earlier name for *Myxarium nucleatum*. However Reid (1970) considered *T. hyalina* to be inadequately described and unidentifiable, a view shared here. *Tremella hyalina* is thus a *nomen dubium*, *M. hyalinum sensu* Donk a synonym of *Exidia nucleata*.

Sebacina laccata Bourdot & Galzin, *Bull. Soc. Mycol. France* 39: 262 (1924)

Exidiopsis laccata (Bourdot & Galzin) Luck-Allen, in K. Wells, *Mycologia* 53: 340 (1961)

Myxarium laccatum (Bourdot & Galzin) D.A. Reid, *Trans. Brit. Myc. Soc.* 55: 428 (1970)

Type specimen examined: **FRANCE**: AVEYRON: L'Hospitalet (Larzac), on *Pinus*, 25 Apr. 1910, A. Galzin 5743 (H. Bourdot 7199), (lectotype) **PC**.

The lectotype of *Sebacina laccata* (cited above) was selected and redescribed by Hauerslev (1993). The specimen contains a variable proportion of stalked, sometimes myxarioid basidia intermixed with normal, unstalked basidia typical of the genus *Exidiopsis*. It also contains oddly shaped elements in the hymenium which presumably represent aborted basidia. These elements, plus the occasional stalked basidia, appear to be artefacts caused by the swelling and distortion of the gelatinous matrix, probably as a result of sudden heavy rain. If this is true, then the lectotype of *Sebacina laccata* is no more than an atypical specimen of *Exidiopsis effusa*, which it otherwise closely resembles. It is here considered a synonym.

Reid (1970) created the combination *Myxarium laccatum* based on a misinterpretation of an English specimen of *Stypella grilletii* (see above).

Sebacina mesomorpha Bourdot & Galzin, *Bull. Soc. Mycol. France* 39: 262 (1923)

Myxarium mesomorphum (Bourdot & Galzin) Hauerslev, *Mycotaxon* 49: 243 (1993) [comb. inval.]

Type specimen examined: **FRANCE**: AVEYRON: Boutaran, on *Rosa*, 12 May 1914, A. Galzin 15287 (H. Bourdot 13949), (lectotype) **PC**.

Re-examination of the lectotype, selected by Hauerslev (1993) and cited above, indicates that *Sebacina mesomorpha* is similar to *Exidiopsis opalea*, but differs in having consistently long-stalked basidia. Wells (1961) considered *S. mesomorpha* to be a synonym of *Exidiopsis laccata*, but as well as the differences in basidia morphology, the basidiospores of the latter are considerably larger. Hauerslev (1993) separated the two species on the basis of spore size, but placed both in the genus *Myxarium* (though the combination '*Myxarium mesomorphum*' is invalid on a technicality, since the publication date of the basionym was not given). If *Sebacina mesomorpha* is an independent taxon and not just based on atypical material of *Exidiopsis opalea*, it should be recombined in *Exidiopsis*. More specimens need to be examined first.

Stypella minor Möller, Protobasid.: 77 (1895)

Stypella minor was collected by Möller in Brazil and provided part of the original concept of the genus *Stypella*. However, no type or original collections are known. As described and illustrated by Möller (1895), *S. minor* appears to be a typical *Stypella* species distinguished by having sparse, slightly thick-walled, sterile hyphae, around 3 µm wide, forming the central portion and apex of each individual basidiome. Basidiospores were said to be oval, 6 x 3 µm. If the thick-walled hyphae were ignored, *S. minor* might be conspecific with *S. grilletii*, though it has often been interpreted as an earlier name for *S. glaira*. For the moment, it is considered a *nomen dubium*.

Exidia nucleata (Schwein.) Burt, *Ann. Miss. Bot. Gard.* 8: 371 (1921)

Tremella nucleata Schwein., *Naturf. Ges. Leipzig Schr.* 1: 115 (1822)
Myxarium nucleatum Wallr., Flora Crypt. Germaniae: 26 (1833)
Exidia tremelloides L.S. Olive, *Mycologia* 43: 682 (1951)
Myxarium tremelloides (L.S. Olive) Wojewoda, Mala Flora Grzybów 2: 58 (1981)

Type specimen examined: **USA**: LOUISIANA: near Lake Verret, on corticate frondose limb, 10 Mar. 1949, L.S. Olive LA 139, (holotype of *Exidia tremelloides*) **NY**.

Exidia nucleata resembles *Stypella* species in being gelatinous, having consistently myxarioid basidia, and having a prominent layer of dendrohyphidia at the hymenial surface. However, basidiomes are produced singly or in small scattered groups, are not geotropic, and become large and pustular or cerebriform, whether single or coalesced. The basidia are substantially larger than those of *Stypella* species (8 - 11.5 µm wide compared to an average of 4.5 - 7.5 µm wide), and the spores typically large, allantoid, and *Exidia*-like. It seems therefore that the resemblance of *Exidia nucleata* to *Stypella* species is coincidental and based mainly on the presence of myxarioid basidia.

Examination of the type of *Exidia tremelloides* shows it to be synonymous with *E. nucleata*. The 'conidia' illustrated by Olive (1951) appear to be allantoid basidiospores from a nearby fungus, possibly *Tulasnella danica* Hauerslev.

Myxarium cinnamomescens (Raitv.) Raitv. may be a further synonym, since old basidiomes of *M. nucleatum* tend to turn sordid brown, a feature of Raitviir's species. The type has not been re-examined. *Myxarium hyalinum sensu* Donk (1966) is synonymous with *E. nucleata*.

European specimens of *E. nucleata* appear identical to American ones, and without further evidence there is no reason to consider them distinct. The European *Myxarium nucleatum* is thus considered a synonym of the American *Exidia nucleata*.

Protodontia oligacantha G.W. Martin, *Jour. Wash. Acad. Sci.* 43: 16 (1953)

Based on the type description and illustrations, this Canadian taxon is clearly unrelated to *Protodontia*, having an effused brown basidiome with fimbriate margin, non-myxarioid basidia, and comparatively large allantoid spores. It would appear to be referable to the genus *Heterochaete*.

Protohydnum piceicola Kühner ex Bourdot, *Bull. Soc. mycol. France* 48: 205 (1932)

Acia sibirica Pilát, *Bull. Soc. Mycol. France* 51: 396 (1936)
Protodontia piceicola (Kühner ex Bourdot) G.W. Martin, *Stud. Nat. Hist. Iowa St. Univ.* 19 (3): 63 (1952)

Specimens examined: **INDIA:** HIMACHAL PRADESH: Mahasu, Khadrala, on wood under conifers, 26 Aug. 1971, S.S. Rattan 4346, (as *Protodontia uda*) **K(M) 49356**; **JAPAN:** IBARAKI PREF.: Mount Tsubaki, on wood, 7 Nov. 1991, L. Ryvarden 30408, **K(M) 49368. SWEDEN:** UPPLAND, Upsala-Näs parish, Ekensberg, Silva Nosten, on decaying conifer boards, 17 Oct. 1947, J. Eriksson 2322 & G. Lindberg, **K(M) 49354** & **K(M) 49355**.

Protohydnum piceicola macroscopically resembles the genus *Mucronella* Fr., having a multitude of distinct spines (up to 3 mm long in well-developed specimens) with little or no subiculum. The spines are fertile except at the extreme apex and have a context of pseudo-dimitic, often brownish and occasionally encrusted hyphae. Strid (1986) notes that the spines may be branched, illustrating this with a photograph. Hyphidia appear to be absent. Its relationship with *Stypella* is doubtful and the species is referred to the tropical genus *Protohydnum*, *pro tem.*

Stypella robusta Lowy, *Trans. Mycol. Soc. Japan* 7: 1 (1966)

Lowy (1966) offered no reasons for referring this Brazilian taxon to *Stypella*, but it is presumed that the macroscopic characters of the basidiome ('a tenuous, nearly colorless film' composed of 'miniscule greyish spots') were the paramount or sole reason. According to Lowy (1966), the basidia are large ('13 - 15.5 µm' wide) and, based on the accompanying illustration, do not possess enucleate stalks. The basidiospores are ellipsoid, '8 - 9.5 x 6 - 8 µm'. It seems improbable that *S. robusta* has any close relation to *Stypella*. The holotype cannot presently be found at LSUM.

Tremella rosea Höhn., *Annls Mycol.* 1: 394 (1903)

Type specimen examined: **AUSTRIA:** Vienna, Prater, on dry stems of *Parieteria officinalis*, 15 Mar. 1903, F.X.R. von Höhnel, (holotype) **FH.**

Known only from the type specimen (cited above), *Tremella rosea* was listed in 'Microtremella' by Donk (1966), together with a number of *Stypella* species. Re-examination of the holotype shows that it is a genuine *Tremella* species, probably parasitic on a coelomycete, and wholly unrelated to the genus *Stypella*.

Stypella variabilis L.S. Olive, *Trans. Brit. Mycol. Soc.* 82: 735 (1984)

This taxon, cultured from dead fern leaves collected in Hawaii, lacks clamp connexions and has large non-myxarioid basidia up to 20 µm wide. Though the account by Olive (1984) is extensive and well-illustrated, it is not clear why the material was referred to the genus *Stypella*. The herbaceous substratum, small pustular basidiomes, lack of clamp connexions, large basidia, and large basidiospores ('12 - 18.7 x 6.8 - 10.2 µm') are typical of the genus *Efibulobasidium* K. Wells, and close to the type species, *Efibulobasidium albescens* (Sacc. & Malbr.) K. Wells, to which *Stypella variabilis* is referred.

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MYCOTAXON

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SPICULOGLOEA OCCULTA (HETEROBASIDIOMYCETES) MORPHOLOGY AND CULTURE CHARACTERS

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ABSTRACT

The morphology of the mycoparasitic Heterobasidiomycete *Spiculogloea occulta* P. Roberts is described, illustrated and discussed. Culture characters and a key comparing intrahymenial auricularioid Heterobasidiomycetes is provided.

Key words: Basidiomycetes, Heterobasidiomycetes, *Spiculogloea*, mycoparasitism, morphology, distribution, culture characters.

INTRODUCTION

The genus *Spiculogloea* (Heterobasidiomycetes) was described by P. Roberts (1996) for a mycoparasite with ornamented basidia growing in the basidiocarp of *Hyphoderma argillaceum* (Bres.) Donk (Aphyllophorales, Corticiaceae) collected on the Balearic Island of Majorca. A second specimen was recorded from England (P. Roberts, 1997) growing in the basidiocarp of *Hyphodontia sambuci* (Pers.: Fr.) J. Erikss. (Aphyllophorales, Corticiaceae). During a survey of the genus *Hyphodontia* J. Erikss. (E. Langer, 1994) another locality has been detected for *S. occulta*, namely in Germany. Further records of *S. occulta* are known from The Netherlands (Van de Put, 1998) and France (Trichies, 1997).

The systematics of auricularioid Heterobasidiomycetes was interpreted by Oberwinkler & Bauer (1989) using a range of criteria, including ultrastructure. Since then many new taxa have been described (e.g. Oberwinkler, 1990; P. Roberts, 1997).

DESCRIPTION

Basidiocarp none. Hitherto found growing in the basidiocarps of *Hyphodontia sambuci* and *Hyphoderma argillaceum*, its basidia emerging through the hymenium of the host. Infected areas of the host hymenium looking watery to gelatinous under hand lens (10x).
Basidiospores 7-8 x 4.5-5 µm, ovoid to ellipsoid, thin-walled, smooth, hyaline, inamyloid. Producing secondary spores or microconidia. Fig. 2C.
Basidia 40-50 x 3.5-5 µm, transversally septate (auricularioid), four-celled, slightly thick-walled and ornamented with fine granules, cyanophilous. Stalk without ornamentation but with basal clamp. Sometimes a probasidial swelling may be seen on the stalk. Fig. 1, arrow A.
Sterigmata four, up to 45 x 2-3 µm, basally somewhat inflated, smooth and thin-walled.
Cystidia none.
Clamps present at all primary septa, one clamp per septum.
Conidia produced in clusters on hyphae located in basal parts of the host basidiocarp. Variable in shape, mostly oblong to cylindrical. 3-5 x 1-2.5 µm. Fig. 1, arrow B.
Haustorial cells sometimes present but very difficult to observe, attached to host hyphae. Filiform in shape with inflated base and basal clamp, resembling haustoria of the genus *Tremella*. Fig. 1, arrow C, Fig. 2A.
Hyphae 1-2.5 µm in diameter, interspersed between the host hyphae, showing irregular inflations. Hyphal walls in comparison to the host very faint in contrast.
Specimens studied: GEL 607, Germany, Baden-Württemberg, Sandhausen, Bannwald Franzosenbusch, ca. 150 m alt., in basidiocarps of *Hyphodontia sambuci* on *Sambucus nigra* L., leg. E. Langer, 30.11.1987, (Fig. 1), in herbarium G. & E. Langer, duplicate in K. GEL 2207, Germany, Baden-Württemberg, Sandhausen, Bannwald Franzosenbusch, ca. 150 m alt., in basidiocarps of *Hyphodontia sambuci* on *Sambucus nigra*, leg. E. Langer, 27.11.1990, in herbarium G. & E. Langer, duplicate in K.
Culture characters observed on MYP-agar (Bandoni, 1972 modified after G. Langer, 1994). Spore prints obtained from infected *H. sambuci* on MYP-agar were germinated under room temperature. The parasite could easily be distinguished by the mycelium growing from spores of *H. sambuci* because of its yeast-like growth. The yeast-like colonies could easily be separated to subculture. Yeast-like colonies grew slowly, after one month reaching 2-5 mm in diameter. Colonies cream coloured, rather hard and becoming brittle

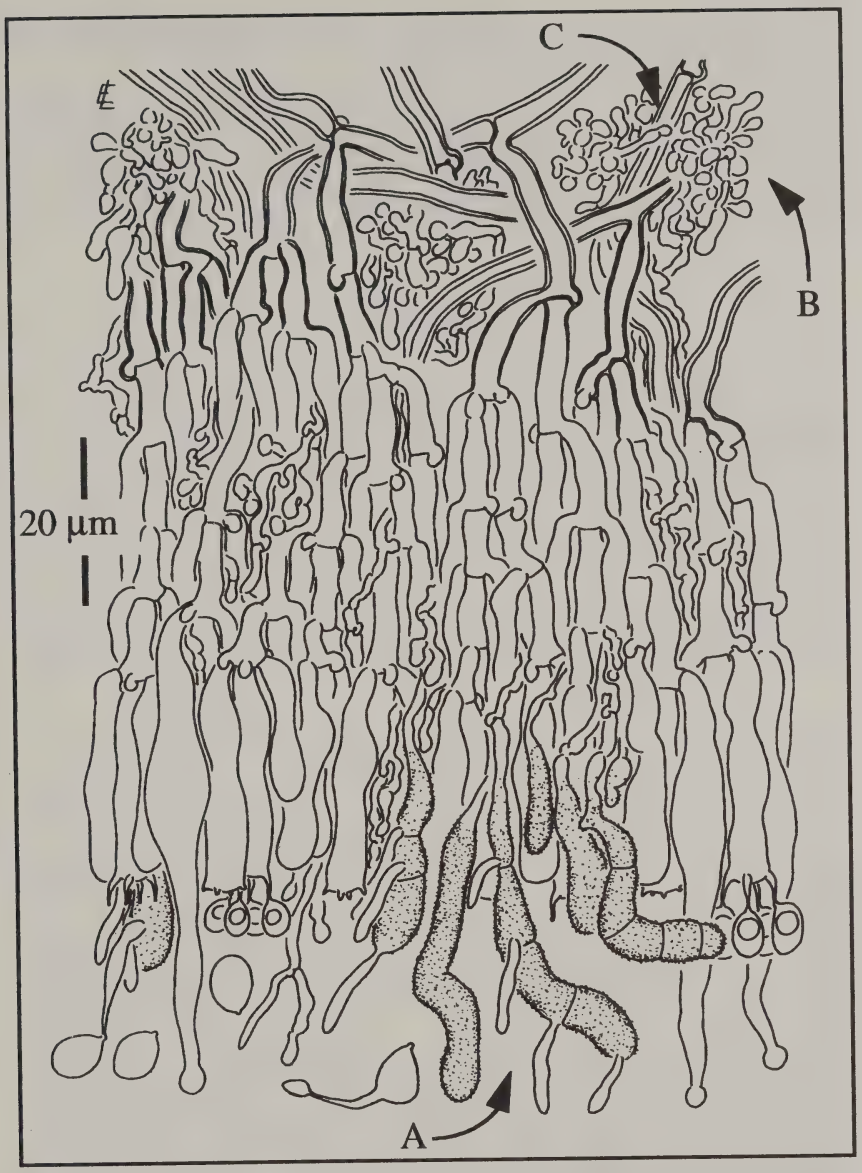


Fig. 1. *Spiculogloea occulta*, illustrated from specimen GEL 607. Cross-section of the host basidiocarp of *Hyphodontia sambuci* with basidial clusters of the parasite *Spiculogloea occulta* (arrow A). In basal parts of the host basidiocarp big clusters of conidia are produced (arrow B). Haustorial cell attached to host hypha (arrow C). Del. E. Langer.

when old, not consisting of single yeast cells but of irregularly connected cells budding off daughter cells. Fig. 2B.

Habitat and substrate: Specimens GEL 607 and GEL 2207 have been collected on *Sambucus nigra* growing in a floodplain forest near the river Rhein comprising *Pinus sylvestris* L., *Fagus sylvatica* L., *Carpinus betulus* L. on sandy ground with scattered sand dunes. Climate is temperate with mild, humid winter and warm and rather dry summer.

DISCUSSION

All of the hitherto recorded *S. occulta* specimens have been collected in temperate or mediterranean areas. For fungi humid winters and arid summers demand a good adaptation to extreme climatic situations. This is true especially for one of the known hosts of *S. occulta*, namely *Hyphodontia sambuci*, a corticioid Basidiomycete growing mainly on branches and twigs of standing *Sambucus* species in Europe. It can survive dry periods even though it is exposed to the air. Identical adaptations can be found in related species (E. Langer, 1994, see Figs. 46, 49, 95). By exudation of crystalline calcium oxalate (Keller, 1985) into the subhymenium, basal parts of the corticioid basidiocarp are protected against evaporation. Therefore *S. occulta* is able to survive within its host.

As well as the generic type, *S. occulta*, another species has been described in the genus *Spiculogloea* (P. Roberts, 1997). *S. minuta* P. Roberts, found in the hymenium of *Tulasnella violea* (Quél.) Bourdot & Galzin. It is delimited from *S. occulta* by smaller basidia and fusiform spores. Other genera sharing common characters with *Spiculogloea* are *Occultifur* Oberw. and *Zygogloea* P. Roberts, all showing *Tremella*-like haustorial cells and production of conidia. Auricularioid, mycoparasitic Heterobasidiomycetes lacking real basidiocarps are found in the genera *Colacogloea* Oberw. & Bandoni, *Cystobasidium* Lagerh., *Kryptastrina* Oberw., *Naohidea* Oberw. and *Phragmoxenidium* Oberw. Their systematics, morphology and ultrastructure has been studied in detail by Oberwinkler & Bauer (1989), Oberwinkler (1990), Oberwinkler *et al.* (1990a) and Oberwinkler *et al.* (1990b). Because not many collections of mycoparasitic Heterobasidiomycetes lacking basidiocarps are known, the use of their hosts for delimitation in keys is questionable. Nevertheless it is probable that many fungi are potential hosts for mycoparasites. As ultrastructural data cannot be obtained through ordinary light microscopy, a generic key based on micromorphological characters can provide help, both to encounter known mycoparasitic species and to discover unknown taxa.

Key to intrahymenial auricularioid Heterobasidiomycetes:

Basidiospores pyramidally tetrahedal in shape ..... *Kryptastrina*
Basidiospores globose, ellipsoid or fusiform
  Probasidial swelling strikingly present ..... *Cystobasidium*
  Probasidial swelling not present or indistinct
    Tremella-like haustorial cells present
      Basidia ornamented with granules ..... *Spiculogloea*
      Basidia smooth
        Conidia in pairs forming 'zygoconidia' ..... *Zygogloea*
        Conidia singly subtended by clamps ..... *Occultifur*
    Tremella-like haustorial cells absent
      Basidia able to form 'endospores' internally ..... *Naohidea*
      Basidia exclusively forming 'exospores' (basidiospores)
        Clamps present ..... *Colacogloea*
        Clamps absent ..... *Phragmoxenidium*

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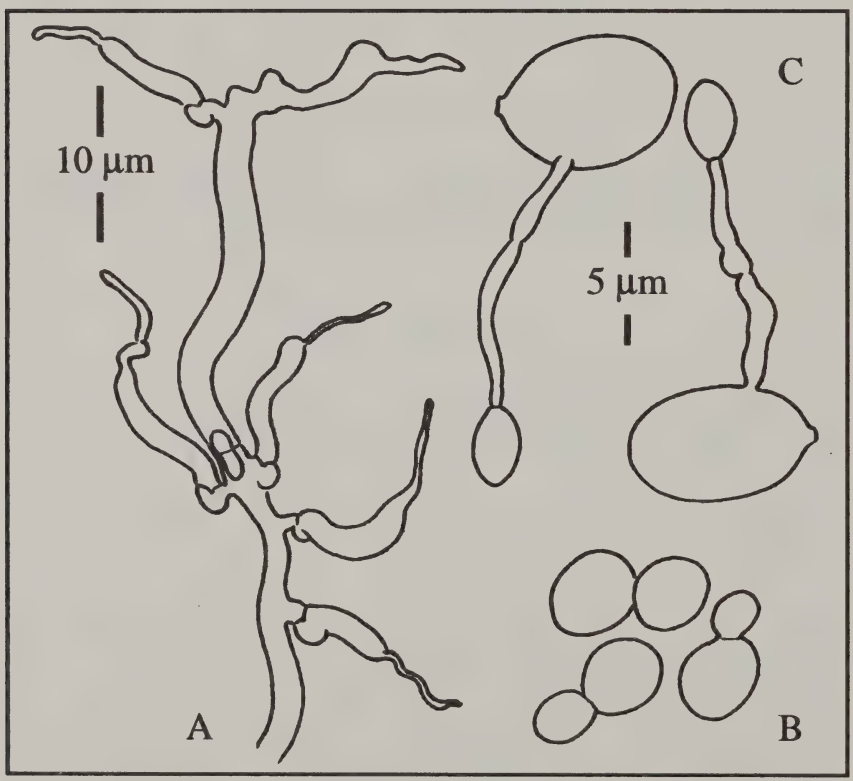


Fig. 2. *Spiculogloea occulta*, illustrated from specimen GEL 2207. A: Hypha with Tremella-like haustorial cells. B: Budding yeasts in pure culture with daughter cells adhering to mother cells. C: Basidiospores with germ tube producing microconidia. Del. F. Oberwinkler.

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THE SPECIES OF HYPOTRACHYNA (PARMELIACEAE, LICHENIZED ASCOMYCOTINA) FROM THE SEGUNDO PLANALTO IN THE STATE OF PARANA, BRAZIL

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ABSTRACT : Twenty species of the genus *Hypotrachyna* (Vain.) Hale have been recorded following an intensive survey of the Segundo Planalto of the state of Paraná (southern Brazil). This has resulted in the known distribution of 16 species being extended, with *H. pustulifera* (Hale) Skorepa reported for the first time for South America. *H. eitenii* (Hale) Hale, *H. malmei* (Lynge) Hale and *H. primitiva* Hale & López-Fig. are recorded for the first time outside their type localities. *H. minima* (Lynge) Hale is synonymized with *H. malmei* (Lynge) Hale. Significant new chemical data are recorded for 14 of the species.

Introduction

The present work is part of an intensive survey of the Parmeliaceae s. str. of the Segundo Planalto in the state of Paraná, southern Brazil. Campos Gerais, the region of study, is approximately 19,000 km^2 in area with altitudes between 730 and 1100 m a.s.l. and is delimited by the following latitudes and longitudes: 24°30´-26°06´S and 49°49´-50°25´W. The predominant type of vegetation is a natural pasture consisting mainly of

low grasses and shrubs with coppices developing in depressions and along river margins, and of cerrado vegetation (comparable with the African savannah). The climate has been characterized as subtropical-temperate with some nocturnal frosts in winter, a mean annual precipitation of 1422.8 mm and a mean annual temperature of 17.6°C (Maack, 1981). In open parts of this area, sandstone rocks are the main lichen substrate.

The genus *Hypotrachyna* is richly represented in the Segundo Planalto with a total of 20 species observed, which represented *ca.* 23% of the diversity of Parmeliaceae *sensu stricto*. The species are described below. This study has resulted in the known distribution of 16 species being extended. Significant new chemical data are recorded for 14 of the species.

MATERIALS AND METHODS

The specimens studied were mainly collected by the first author in the Segundo Planalto of the state of Paraná (Brazil), and are housed in the herbaria indicated. Type specimens examined were obtained on loan from BM, G, O, S, US and TUR.

The abbreviations for herbarium names follows that of the Index Herbariorum (Holmgren et al., 1990). Lichen substances were identified by thin layer chromatography (Elix & Ernst-Russell 1993; Elix *et al.* 1988), and where necessary confirmed by high performance liquid chromatography (Feige *et al.* 1993) and comparison with authentic samples.

THE SPECIES

1. **Hypotrachyna bahiana** (Nyl.) Hale, Smithsonian Contr. Bot. 25: 23 (1975).

Thallus corticolous, adnate, orbicular, up to 5 cm diam.; lobes sublinear, subdichotomously branched, 1-2 mm broad. Upper surface plane, grey, without isidia and soredia. Medulla white. Lower surface black, densely rhizinate, rhizines densely dichotomously branched, reaching the lobe margins and occasionally horizontal (parallel to the substrate). Apothecia adnate, 2-5 mm diam., ascospores 10-13 x 5-8 µm; pycnidia frequent, conidia bifusiform, 6-7.5 µm long.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K-, C+ pale yellow, KC+ pale yellow (protocetraric acid, major).

Specimens examined: BRAZIL. Paraná, Jaguariaíva, Parque Estadual do Cerrado, corticolous, 16.iv.1994, *S. Eliasaro 1266, 1275* (UPCB 28673, 28691), 19.iv.1995, *S. Eliasaro 1374* (UPCB 28729, BAFC 39007).

Hale (1975) reported *H. bahiana* from Haití and Brazil - including the states of Bahía (Northeastern Region), Minas Gerais and Rio de Janeiro

(Southeastern Region). More recently Pereira & Marcelli (1989) extended the distribution of this species to São Paulo (Southeastern Region) while Nash & Elix (1987) recorded it from Africa.

This species is here reported for the first time from the state of Paraná (Southern Brazil), the southermost record in South America.

2. Hypotrachyna brasiliana (Nyl.) Hale, Smithsonian Contr. Bot. 25: 25 (1975).

Thallus saxicolous, loosely attached to the substrate, orbicular to irregularly spreading, up to 11 cm diam.; lobes sublinear, subdichotomously branched, 1-3 mm broad, rarely with marginal lobules. Upper surface plane, whitish-grey to yellowish-white, without isidia and soredia. Medulla white. Lower surface black, moderately rhizinate, rhizines simple or mostly dichotomously branched, reaching the margins of the lobes and directed to the substrate. Apothecia adnate, up to 9 mm diam., disc concave, dark brown, ascospores 8-13 x 5-6.5 (-8) µm. Pycnidia frequent, conidia bifusiform 6-7.5 µm long.

Chemistry: Upper cortex K-, UV+ yellow (lichexanthone, major); medulla K- or K+ pale yellow, C- or C+ pale yellow, KC+ pale pink (protocetraric acid, major; gyrophoric acid, minor/trace; virensic acid, minor/trace).

Specimens examined: BRAZIL. Paraná, Tibagí, Canion Guartelá, 22.i.1996, *S. Eliasaro 1459, 1461, 1468, 1469* (UPCB 28674, 28675, 28692, 28693), *S. Eliasaro 1479* (CANB); Ponta Grossa, Parque Estadual do Vila Velha, 27.ix.1995, *M. Bündchen 61* (UPCB 28704), 23.i.1996, *S. Eliasaro 1545, 1550* (28723, 28733), 27.i.1996, *S. Eliasaro 1562* (UPCB 28737), *S. Eliasaro 1564* (BAFC 39006, UPCB 28741); Fortaleza, *S. Eliasaro 1600* (UPCB 28746); Lapa, near Parque Estadual Gruta do Monge, 6.ii.1996, *S. Eliasaro 1658, 1673, 1676, 1677* (UPCB 28761, 28769, 28772, 28773).

H. brasiliana was formerly reported from Brazil by Hale (1975) - from Mato Grosso (West-central Region), Minas Gerais, Rio de Janeiro and São Paulo (Southeastern Region) and Santa Catarina (Southern Brazil). Its distribution is here extended to the state of Paraná. Gyrophoric and virensic acids have not been reported previously for this species.

This saxicolous species is quite common in the Segundo Planalto of Paraná, growing on sandstone rocks in exposed sites, and more rarely on roots of bushes.

3. Hypotrachyna chlorina (Müll. Arg.) Hale, Smithsonian Contr. Bot. 25: 28 (1975).

Thallus saxicolous, adnate, irregularly spreading over the substrate, up to 8 cm diam.; lobes 1.5-3 mm broad, irregularly branched, with plane or ascending marginal lobules. Upper surface plane, greenish-grey, maculate,

with ascending lobules, up to 0.5 mm long; without isidia or soredia. Medulla greenish-yellow. Lower surface black, moderately rhizinate, rhizines sparsely dichotomously branched, mostly parallel to the substrate. Apothecia immature. Pycnidia frequent, conidia bifusiform 4.5-5.5 µm long.

Chemistry: Upper cortex K+ yellow (atranorin, minor; chloroatranorin, minor); medulla K-, C+ orange, KC+ orange (barbatic acid, minor; obtusatic acid, major; secalonic acid A, major; evernic acid, minor/trace).

Specimens examined: BRAZIL. Paraná, Ponta Grossa, Parque Estadual de Vila Velha, 8.x.1996, *S. Eliasaro 1831a* (UPCB 28851, BAFC 39005); Lapa, Parque Estadual Gruta do Monge, on sandstone, 6.ii.1996, *S. Eliasaro 1731b* (UPCB 28676). Rio de Janeiro, Petrópolis, *Deventer*, lectotype selected by Hale (G).

H. chlorina was previously recorded by Hale (1975) from Haití, Panamá, Venezuela and southeastern Brazil (Minas Gerais and Rio de Janeiro). It is here recorded for the first time for southern Brazil, its southernmost record. Evernic acid has not been reported previously as occurring in this species.

This species was usually found growing over saxicolous lichens and mosses.

4. Hypotrachyna costaricensis (Nyl.) Hale, Smithsonian Contr. Bot. 25: 29 (1975).

Thallus corticolous, adnate, up to 10 cm diam.; lobes irregular, 1-1.5 mm broad. Upper surface plane, greenish-grey, densely isidiate, isidia cylindrical, simple to branched. Medulla white. Lower surface black, densely rhizinate, rhizines densely dichotomously branched, reaching the lobe margins, parallel to the substrate in the lobe axils. Apothecia and pycnidia not seen.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K-, C-, KC- (protolichesterinic acid, major; unidentified fatty acids, minor).

Specimens examined: BRAZIL. Paraná, Ponta Grossa, Buraco do Padre, 27.i.1996, *S. Eliasaro 1615, 1619* (UPCB 28677, 28705), *S. Eliasaro 1624* (BAFC 39004, UPCB 28734).

H. costaricensis was reported previously from México, Jamaica, Haiti, Colombia, Venezuela, Peru, Bolivia and Brazil (Minas Gerais and Rio de Janeiro) by Hale (1975); from Pará (Brako *et al.* 1985); from São Paulo (Pereira & Marcelli 1989) and from Australia, Papua and New Guinea by Elix (1994). Its distribution is now extended to the state of Paraná.

This corticolous species is uncommon in the Segundo Planalto.

5. Hypotrachyna degelii (Hale) Hale, Smithsonian Contr. Bot. 25: 31 (1975).

Thallus loosely adnate, saxicolous, up to 10 cm diam.; lobes sublinear, 1-3 mm broad. Upper surface grey, plane, emaculate to faintly maculate, eventually with lobules at the centre, lacking soredia and isidia. Medulla white. Lower surface black, sparsely to densely rhizinate, rhizines moderate to densely dichotomously branched, directed to the substrate. Apothecia adnate to substipitate, up to 2 mm diam., margin crenulate, disc brown, asci immature. Pycnidia with bifusiform conidia, 6.5-8 µm long.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K-, C+ pale pink, KC+ pink becoming orange (alectoronic acid, major; α-collatolic acid, major).

Specimens examined: BRAZIL. Minas Gerais, Caeté, Serra da Piedade, 16.v.1987, *S. Eliasaro* (BHCB 9368). Paraná, Ponta Grossa, near Vila Velha, saxicolous, 23.i.1996, *S. Eliasaro 1544* (UPCB 28718); Lapa, near Gruta do Monge, on sandstone, 6.ii.1996, *S. Eliasaro 1665* (UPCB); Parque Estadual Gruta do Monge, on sandstone, 6.ii.1996, *S. Eliasaro 1732, 1735, 1737* (UPCB 28726, 28730, 28732).

H. degelii was formerly reported from México, Jamaica, Haiti, Colombia, Venezuela, Peru, Bolivia and Brazil (Rio Grande do Sul and Mato Grosso) by Hale (1975) and from Minas Gerais by Marcelli (1993). It is here recorded for the first time from the state of Paraná.

6. Hypotrachyna dentella (Hale & Kurok.) Hale, Smithsonian Contr. Bot. 25: 33 (1975)

= *Parmelia laevigata* var. *ceratina* Müll. Arg.

Thallus corticolous, loosely attached to the substrate, up to 6 cm diam.; lobes irregular, short, 2-3 mm broad. Upper surface plane, greenish-grey, maculate, densely isidiate, isidia cylindrical, erect mostly simple, rarely branched, with dark apices. Medulla white. Lower surface black, moderately rhizinate, rhizines sparsely dichotomously branched. Apothecia and pycnidia not seen.

Chemistry: Upper cortex K+ yellow (atranorin, minor; chloroatranorin, minor; isousnic acid, minor); medulla K+ yellow, C-, KC- (echinocarpic acid, major; barbatic acid, minor; conechinocarpic acid, minor; 4-*O*-demethylbarbatic acid, minor/trace; norobtusatic acid, minor/trace; obtusatic acid, minor; unknown, minor).

Specimens examined: BRAZIL. Paraná, Ponta Grossa, Vila Velha, 1.ix.1996, *S. Eliasaro 1811* (UPCB 28806), *S. Eliasaro 1846* (BAFC 39003, CANB, UPCB 28820). Rio de Janeiro, Petrópolis, *Deventer* (G, lectotype of *Parmelia laevigata* var. *ceratina* Müll. Arg. selected by Hale).

H. dentella has been reported previously from the USA, México, Venzuela and Brazil (Rio de Janeiro) by Hale (1975), Rio Grande do Sul (Osorio 1988),

São Paulo (Pereira & Marcelli 1989) and Minas Gerais (Eliasaro & Adler 1997). The distribution of this species is now extended to the state of Paraná. Isousnic acid and conechinocarpic acid have not previously been reported from this species.

This infrequent corticolous species was collected on the Segundo Planalto in humid, shaded sites.

7. Hypotrachyna eitenii (Hale) Hale, Smithsonian Contr. Bot. 25: 33 (1975).

Thallus saxicolous, loosely attached, orbicular, up to 5 cm diam.; lobes sublinear, subdichotomously branched, 1-2 mm broad. Upper surface plane, yellowish-grey, without isidia or soredia. Medulla white, salmon-pink near the lower cortex. Lower side black, sparse to moderately rhizinate, rhizines simple to sparsely dichotomously branched. Apothecia at the centre of the thallus, adnate, disc concave, dark brown, 1-4 mm diam., ascospores 8-10 x 5-6 µm. Pycnidia frequent, conidia bifusiform, 8-12 µm long.

Chemistry: Upper cortex K- (lichexanthone, major); medulla K-, C+ dark red, KC+ red (anziaic acid, major; unidentified substances, minor).

Specimens examined: BRAZIL. Paraná., Ponta Grossa, Vila Velha, 8.x.1996, *S. Eliasaro 1835* (UPCB 28853); Lapa, Parque Estadual Gruta do Monge, on sandstone, 6.ii.1996, *S. Eliasaro 1731a* (UPCB 28679, BAFC 39002). Rio de Janeiro, Serra dos Orgaos, *G. y I. Eiten 7125* (US-holotype of *Parmelia eitenii* Hale).

Previously H. eitenii was known only from the type locality in the state of Rio de Janeiro. The distribution is here extended to southern Brazil.

On the Segundo Planalto this species was collected growing in open, exposed sites.

8. Hypotrachyna endochlora (Leight.) Hale, Smithsonian Contr. Bot. 25: 34 (1975).

Thallus saxicolous or over mosses, adnate, orbicular, up to 8 cm diam.; lobes 1.5-3 mm broad, irregularly branched. Upper surface plane greenish-grey, strongly maculate, pustulate, pustules mostly on the margins, rarely laminal, becoming sorediate, soredia granular. Medulla greenish-yellow. Lower surface black, moderate to densely rhizinate, rhizines reaching the lobe margins, parallel to the substrate at lobe axils. Apothecia shortly stipitate, up to 8 mm diam., disc plane, dark brown, margin pustulate, ascospores 16-20 x 10-13 µm. Pycnidia infrequent, conidia bifusiform, 4.5-5 µm long.

Chemistry: Upper cortex K+ yellow (atranorin, minor; chloroatranorin, minor); medulla K-, C+ orange, KC+ orange (barbatic acid, minor; obtusatic

acid, major; secalonic acid A, major/minor; evernic acid, minor; norobtusatic acid, trace).

Specimens examined: BRAZIL. Paraná, Ponta Grossa, Vila Velha, on sandstone, 6.ii.1996, *S. Eliasaro 1731a* (BAFC 39002, CANB, UPCB 28679).

H. endochlora was previously reported from México, Central America, Colombia, Venezuela, Europe, South Africa, Madagascar, St. Helena, Hawaii, Brazil (Rio de Janeiro) by Hale (1975); from São Paulo by Pereira & Marcelli (1989); from Rio Grande do Sul by Fleig (1990b) and from Argentina by Adler & Elix (1992). It is here recorded for the first time for the state of Paraná. Evernic acid has not been recorded previously from this species.

H. endochlora is an uncommon species in the Segundo Planalto, where it grows over dead saxicolous lichens and live mosses on sandstone ledges, in very humid, poorly lit sites.

9. Hypotrachyna flavida (Zahlbr.) Hale, Smithsonian Contr. Bot. 25: 37 (1975).

Thallus adnate, yellow-green. Lobes sublinear, short, 0.1-1.3 mm wide, lacking soredia and isidia. Medulla white. Lower surface black; rhizinate to the margin, rhizines dichotomously branched. Apothecia laminal, sessile, disc brown, 2-4 mm diam., ascospores (6-) 7-11x 4-6 µm. Pycnidia not seen.

Chemistry: Upper cortex K- (usnic acid, major); medulla K-, C-, KC- (protocetraric acid, major; physodalic acid, major/minor; virensic acid, minor/trace; ±gyrophoric acid, minor; ±pigmentosin B, minor).

Specimens examined: BRAZIL. Paraná, Tibagí, Guartelá, 17.iv.1994, *S. Eliasaro 1316, 1317, 1318* (UPCB 24713, 24714, 24715), *S. Eliasaro 1467* (CANB).

H. flavida has been reported previously from Colombia, Venezuela, Peru and Brazil (Bahia, Minas Gerais, Rio de Janeiro) by Hale (1975) and from the state of Paraná by Eliasaro & Adler (1997). Virensic acid, gyrophoric acid and pigmentosin B have not previously been reported from this species.

10. Hypotrachyna imbricatula (Zahlbr.) Hale, Smithsonian Contrib. Bot. 25: 41.(1975).

Thallus corticolous or growing on saxicolous mosses, adnate, orbicular or irregularly spreading, up to 8 cm diam.; lobes sublinear, subdichotomously branched, 2-3 mm broad, the margin black. Upper surface plane, whitish-grey, emaculate or maculate, densely isidiate, isidia cylindrical, eventually decumbent, laminar to subterminal, simple to branched, darkening apically, sometimes ciliate at the base, 0.3-0-5 mm long. Medulla white. Upper surface black, densely rhizinate, rhizines dichotomously branched, reaching

the lobe margin and clearly parallel to the substrate (dichotomously branched cilia). Apothecia immature, margin isidiate. Pycnidia not seen.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K-, C+ dark orange, KC+ dark orange (barbatic acid, major/minor; 4-*O*-demethylbarbatic acid, major/minor; obtusatic acid, major/minor; norobtusatic acid, major/minor; 4-*O*-demethylisoobtusatic acid, trace; evernic acid, trace; isoobtusatic acid, trace; lecanoric acid, trace).

Specimens examined: BRAZIL. Paraná, Ponta Grossa, Parque Estadual de Vila Velha, 27.ix.1995, *M. Bündchen 77* (UPCB 28711), *S. Eliasaro 1831b, 1839* (UPCB 28852, 28854); Buraco do Padre, corticolous, 27.i.1996, *S. Eliasaro 1643, 1644* (UPCB 28750, 28711); Lapa, Parque Estadual, Gruta do Monge, on sandstone, 6.ii.1996, *S. Eliasaro 1734* (UPCB 28775), 9.x.1996, *S. Eliasaro 1882* (BAFC 39000, CANB, UPCB).

H. imbricatula often exhibits marginal rhizines (or cilia) which are parallel to the substrate, a feature also observed in other species of this genus. Thus *Hypotrachyna* should not be considered a completely eciliate genus (*c.f.* Hale 1975), since it contains both eciliate and ciliate taxa (as does *Parmotrema*).

This species has been recorded from southeastern USA, southern Chile and Brazil (Bahia, Minas Gerais, Rio de Janeiro, São Paulo and Santa Catarina) by Hale (1975); and from Rio Grande do Sul by Osorio & Fleig (1988). Here we report *H. imbricatula* for the first time for the state of Paraná. This species is also known from Australia, south-east Asia, Papua New Guinea and Hawaii (Elix 1994). 4-*O*-Demethylisoobtusatic acid, evernic acid, isoobtusatic acid and lecanoric acid are reported for the first time from this species.

11. Hypotrachyna intercalanda (Vain.) Hale, Smithsonian Contr. Bot. 25: 42 (1975).

Thallus corticolous, adnate, 4-6 cm diam.; lobes sublinear, 1-2 mm broad. Upper surface plane to rugulose, grey, faintly maculate, lacking isidia, pustules and soredia. Medulla white. Lower surface moderately rhizinate, rhizines moderate to densely dichotomously branched. Apothecia adnate, disc dark to pale brown, up to 7 mm diam., ascospores 8-11 x 5-7 µm. Pycnidia infrequent, submarginal, conidia bifusiform, 5-6.5 µm long.

Chemistry: Upper cortex K+ yellow (atranorin, major/minor; chloroatranorin, minor); medulla K-, C+ red (olivetoric acid, major; anziaic acid, major/minor).

Specimens examined: BRAZIL. Minas Gerais, Ouro Branco, Serra de ouro Branco, 1.x.1988, *K. Marques* (BHCB 14164); Antonio Carlos (Sitio), 1885, *E. Vainio 899* (TUR-lectotype of *Parmelia intercalanda* selected by Hale, dupl. BM). Paraná, Ponta Grossa, Parque Estadual de Vila Velha, 25.vii.1981, *L. Krieger* (BHCB 3261), 27.ix.1995, *M. Bündchen 92* (UPCB 28748); Tibagí, Guartelá, 22.i.1996, *S. Eliasaro 1519b* (UPCB 28712).

H. intercalanda was formerly reported from Brazil (Minas Gerais, São Paulo, Mato Grosso, Paraná, Santa Catarina) and Argentina (Misiones Province) by Hale (1975).

This is a common species in the Segundo Planalto of Paraná. The presence of medullary anziaic acid (in addition to olivetoric acid) has not been reported previously; both substance were present in all the specimens examined as well as in the type.

12. Hypotrachyna livida (Tayl.) Hale, Smithsonian Contr. Bot. 25: 45 (1975).

Thallus adnate, orbicular, up to 7 cm diam.; lobes sublinear, subdichotomously divided, 1-3 mm broad. Upper surface plane, grey, lacking vegetative propagules. Medulla white. Lower surface black, moderate to densely rhizinate, rhizines simple to densely dichotomously branched. Apothecia up to 8 mm diam., ascospores 8-12 x 5-7 µm. Pycnidia frequent, conidia bifusiform 5-6.5 µm long.

Chemistry: Upper cortex K+ yellow (atranorin, major/minor; chloroatranorin, minor); medulla K+ turning faint orange, C- to C+ pale yellow, KC+ transient purplish-pink (4-*O*-methylphysodic acid, major/minor; lividic acid, major/minor; colensoic acid, major/minor; norcolensoic acid, minor; physodic acid minor/trace; oxyphysodic acid, minor/±trace; gyrophoric acid, minor/±trace; hydroxycolensoic acid ±trace).

Specimens examined: BRAZIL. Paraná, Tibagí, Guartelá, 22.i.1996, *S. Eliasaro 1509, 1519a* (UPCB 28713, 28747); Ponta Grossa, Fortaleza, on Palmae, 27.i.1996, S. *Eliasaro 1609, 1613, 1623, 1629b* (UPCB 28776, 28752, 2863, 28779); Buraco do Padre, corticolous, 27.i.1996, *S. Eliasaro 1637, 1641, 1647, 1649* (UPCB 28810, 28811, 28812, 28813).

H. livida was previously reported from southeastern USA, the Bahamas, Venezuela, Uruguay, Argentina and Brazil (Minas Gerais, Rio Grande do Sul, Rio de Janeiro, São Paulo and Santa Catarina) by Hale (1975); and from Mato Grosso by Fleig (1991). This is the first report of this species from the state of Paraná.

13. Hypotrachyna malmei (Lynge) Hale, Smithsonian Contr. Bot. 25: 47 (1975)

= *Hypotrachyna minima* (Lynge) Hale, Smithsonian Contr. Bot. 25: 47 (1975).

Thallus corticolous or saxicolous, adnate, orbicular, up to 6 cm diam.; lobes short, irregular, 0.5-1.5 mm broad. Upper surface whitish-grey, rugulose, dactylate, dactyls mostly closed, sometimes apically open. Medulla white, orange near the lower cortex. Lower surface black, sparsely rhizinate, rhizines simple to sparsely dichotomously branched, thick. Apothecia

adnate, margin dactylate, disc up to 1.5 mm diam., ascospores 8-13 x 5-8 µm. Pycnidia frequent, upon the dactyls, conidia bifusiform 5-6.5 µm.

Chemistry: Upper cortex K- (lichexanthone, major); medulla K-, C+ reddish, KC+ reddish (protocetraric acid, major; pigmentosin B, minor).

Specimens examined: BRAZIL. Mato Grosso, *G. Malme 2950* (S-lectotype of *Parmelia malmei* Lynge selected by Hale), *G. Malme 2947* (S-lectotype of *Parmelia minima* Lynge selected by Hale). Paraná, Jaguariaíva, Parque Estadual do Cerrado, 19.iv.1995, *S. Eliasaro 1361* (UPCB 28714).

In 1960 Hale reported that *H. malmei* was synonymous with *H. minima* (Hale 1960) but later (Hale 1975) treated these two species as separate, but closely related taxa. We agree here with the former view because the respective lectotypes differ only in the density of laminal dactyls and the presence of trace quantities of alectoronic acid in the type of *H. malmei*. We found that the dactyls were sparse on the upper surface of the type of *H. minima*, but not restricted to the apothecial margins. The material from Paraná is densely dactylate like the type of *H. malmei*. Previously this species was known only from the type locality (Mato Grosso). Pigmentosin B, a quinone of unknown structure present in this species, is the major pigment present in *Myelochroa denegans* (Nyl.) Elix & Hale (Elix in sched.).

This rare species was collected on tree trunks in cerrado on the Segundo Planalto, the same habitat occupied by *H. silvatica*, its presumptive parent morph.

14. Hypotrachyna neodissecta (Hale) Hale, Smithsonian Contr.Bot. 25: 49 (1975).

Thallus loosely adnate, up to 5 cm diam.; lobes sublinear, 1-2 mm wide. Upper surface plane, grey, densely isidiate, isidia cylindrical, simple or divrsely branched, darkening apically. Medulla white. Lower surface black, sparse to moderately rhizinate, rhizines sparse to dichotomously branched, always directed to the substrate. Apothecia adnate, margin isidiate, disc brown, up to 4 mm diam, ascospores 8-10 x 5-7 µm. Pycnidia submarginal or on isidia, conidia bifusiform, 5-6.5 µm.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K-, C+ pink, KC+ pink (3-methoxy-2,4-di-*O*-methylgyrophoric acid, major; 3-methoxyumbilicaric acid, submajor; 2,4-di-O-methylgyrophoric acid, minor; gyrophoric acid, minor; lecanoric acid, minor; 5-*O*-methylhiascic acid, minor; umbilicaric acid, minor; 2,4,5-tri-*O*-methylhiascic acid, trace).

Specimens examined: BRAZIL. Paraná, Ponta Grossa, Vila Velha, 23.i.1996, *S. Eliasaro 1541* (BAFC 39008, UPCB); Fortaleza, 27.i.1996, *S. Eliasaro 1601* (BAFC 39009, UPCB). GUINEA. N' Zérekoré, *R. Santesson 10597d* (US-isotype).

H. neodissecta was reported previously from India, Guinea and Venezuela by (Hale 1975) and from South Africa (Transvaal) by Nash & Elix (1987). This is the first report of this species from Brazil. The detailed medullary chemistry of this species had not been elucidated previously.

Although the type material of this species is corticolous, all the specimens collected in the Segundo Planalto were growing on sandstone.

15. Hypotrachyna osseoalba (Vain.) Y.S. Park & Hale, Taxon 38: 88 (1989).

Thallus corticolous, closely adnate, orbicular, up to 2 cm diam.; lobes sublinear, subdichotomously branched, 0.8-1.5 mm wide. Upper surface greyish, pustulate, pustules becoming sorediate, soredia granular. Medulla white, with orange pigment at the base of the pustules. Lower surface black, moderate to densely rhizinate, rhizines densely dichotomously branched, reaching the lobe margins and directed to the substrate. Apothecia and pycnidia not seen.

Chemistry: Upper cortex K- (lichexanthone, major); medulla K+ yellow turning red, C- or C+ pale yellow, KC+ pink (lividic acid, major; 4-*O*-methylphysodic, major/minor; colensoic acid, minor; methoxycolensoic acid, minor/trace; 4-*O*-methyllividic acid, minor/trace; physodic acid, minor/trace; pigmentosin B, minor/trace; skyrin, minor/trace; oxyphysodic acid, trace; norcolensoic acid, ±trace; hydroxycolensoic acid, ±trace).

Specimens examined: BRAZIL. Paraná, Jaguariaíva, Parque Estadual do Cerrado, corticolous, 19.iv.1995, *S. Eliasaro 1384* (UPCB 28715); Lapa, near to Parque estadual Gruta do Monge, corticolous, 6.ii.1996, *S. Eliasaro 1702, 1704* (UPCB 28740, 28743); Parque Estadual Gruta do Monge, *S. Eliasaro 1751, 1752, 1755* (UPCB 28764, 28765, 28777).

H. osseoalba, under the synonym *H. formosana* (Zahlbr.) Hale, has been reported previously from southern Asia, Japan, Africa, México, Guatemala, Panama, Cuba, Haiti, Venezuela, Peru, Chile and Brazil (Rio de Janeiro) by Hale (1975); from Pará (Brako *et al.* 1985) and São Paulo (Marcelli 1990). The above are the first records for the state of Paraná. This species is also known from Australia (Elix 1994). Methoxycolensoic acid and pigmentosin B have not been reported previously from this species.

16. Hypotrachyna pluriformis (Nyl.) Hale, Smithsonian Contr. Bot. 25: 55. 1975.

Thallus corticolous, adnate to loosely adnate, up to 7 cm diam.; lobes sublinear, subdichotomously branched, frequently laciniate or canaliculate, 1-4 mm broad. Upper surface greenish-grey, plane, without isidia or soredia. Medulla white. Lower surface black, pale brown at the lobe apices, frequently with a broad pale brown or beige margin, sparsely rhizinate, rhizines sparse, moderate or densely dichotomously branched. Apothecia

shortly stipitate, disc pale brown. Ascospores 6.5-8.2 x 9.8-14.5 µm. Pycnidia not seen.

Chemistry: Upper cortex K+ yellow (atranorin, minor; chloroatranorin, minor); medulla K-, C+ pink, KC+ pink (gyrophoric acid, major; 5-*O*-methylhiascic acid, major; ovoic acid, minor; lecanoric acid, trace).

Specimens examined: BRAZIL. Paraná, Jaguariaíva, Parque Estadual do Cerrado, 19.iv.1995, *S. Eliasaro 1373* (UPCB 28728); Ponta Grossa, Parque Estadual de Vila Velha, 8.x.1996, *S. Eliasaro 1845* (UPCB 32673); Lapa, near Parque Estadual Gruta do Monge, 6.ii.1996, *S. Eliasaro 1695* (UPCB 28731).

H. pluriformis was formerly reported from México, Uruguay, Argentina and Brazil (Rio de Janeiro, Minas Gerais, São Paulo) by Hale (1975); from Paraná (Osorio 1977) and from Rio Grande do Sul (Osorio *et al.* 1983). Lecanoric acid and ovoic acid have not been reported previously from this species.

17. Hypotrachyna polydactyla (Krog & Swinscow) T. H. Nash, Bryologist 88: 20 (1985).

Thallus adnate, corticolous or saxicolous, up to 7 cm diam.; lobes sublinear, 1-2.5 mm broad. Upper surface plane to rugulose, dactylate, dactyls laminal, closed, simple to irregularly branched, semicrescent shaped, claviform to cerebriform or irregular, internally with loose hyphae surrounding a central bundle of tightly entangled hyphae. Medulla white. Lower surface black, sparse to moderately rhizinate, rhizines moderate to dichotomously branched, lower side of apices brown, papillate. Apothecia and pycnidia not seen.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K-, C+ transient pale pink (lividic acid, major; colensoic acid, major/minor; methoxycolensoic acid, major/minor; oxyphysodic acid, submajor/minor; 4-*O*-methyllividic acid, minor; physodic acid, minor; skyrin, ±minor; 4-*O*-methylphysodic acid, trace; norcolensoic, trace).

Specimens examined: BRAZIL. Minas Gerais, Caeté, Serra da Piedade, saxicolous, 26.x.1987, *S. Eliasaro 541* (BHCB 11862). Paraná, Ponta Grossa, Buraco do Padre, corticolous, *S. Eliasaro 1652* (UPCB 28719), *1629a* (UPCB 28724). AFRICA. KENYA. Central Province, Distr. Kirinyaga, Mt. Kenya, S. side, near Castle Forest Station, on trees, ii.1971, *Krog & Swinscow K49/135* (O-holotype).

H. polydactyla was described by Krog & Swinscow (1979) from Africa, and later reported from the USA (Arizona) by Nash (1985) and from Brazil (Rio Grande do Sul) by Fleig (1990b). We now report *H. polydactyla* from the states of Minas Gerais and Paraná. The detailed medullary chemistry of this species has not been elucidated previously.

18. Hypotrachyna primitiva Hale & López-Fig., Bryologist 81: 592 (1978).

Thallus saxicolous, adnate, orbicular to irregularly spreading over the substrate, up to 13 cm diam.; lobes linear elongate, dichotomously branched, 2-4 mm broad. Upper surface plane, whitish-grey, emaculate to faintly maculate, without isidia or soredia. Medulla white. Lower surface black, densely rhizinate, rhizines moderately dichotomously to irregularly branched, reaching the margins and directed to the substrate. Apothecia shortly stipitate, disc plane, dark brown, 3-5 mm diam., ascospores 11.4-13 x 6.5-8.2 µm. Pycnidia not seen.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K+ yellow turning red or pale red, C-, KC- (fumarprotocetraric acid, major; protocetraric acid, minor/trace; ±pigmentosin B, minor).

Specimens examined: BRAZIL. Paraná, Ponta Grossa, Vila Velha, 27.ix.1995, *S. Eliasaro 1449* (UPCB 28717); Lapa, near Gruta do Monge, on sandstone, 6.ii.1996, *S. Eliasaro 1660* (BAFC 39011, CANB, UPCB 28738)), *S. Eliasaro 1667, 1668* (UPCB 28759, 28760); Parque Estadual Gruta do Monge, on sandstone, 6.ii.1996, *S. Eliasaro 1723, 1733* (UPCB 28767, 28770). Santa Catarina, Morro do Pinheiro Seco, Lajes, saxicolous, 14.vii.1963, *Reitz & Klein 15.727* (CANB, US).

Previously *H. primitiva* was only known from the type collection from Merida, Venezuela (Hale & López Figueiras 1978), but its distribution is here extended to Brazil (Paraná and Santa Catarina). This species grows directly on rock or over saxicolous lichens or mosses.

19. Hypotrachyna pustulifera (Hale) Skorepa, Phytologia 53: 445 (1983).

Thallus corticolous or saxicolous, adnate, orbicular, up to 8 cm diam.; lobes sublinear, 0.8-2 mm wide. Upper surface plane to rugulose, whitish-grey to yellowish-white, dactylate, dactyls closed or abrading apically becoming open, and eventually sorediate, soredia coarse. Medulla white, pigmented yellow below the dactyls. Lower surface black, moderately rhizinate, rhizines sparsely dichotomously branched. Apothecia adnate, margin dactylate, disc dark brown, up to 4 mm diam., ascospores 10-13 x 5-6.5 µm. Pycnidia rare, laminal, conidia bifusiform, 6-8 µm.

Chemistry: Upper cortex K+ yellow (atranorin, major; chloroatranorin, minor); medulla K+ yellow turning red, (lividic acid, major; colensoic acid, major; methoxycolensoic acid, major; 4-*O*-methylphysodic acid, submajor; norcolensoic acid, minor; gyrophoric acid, minor; physodic acid, minor; oxyphysodic acid, minor; 4-*O*-methyllividic acid, minor; lecanoric acid, minor; unknown pigment, minor).

Specimens examined: BRAZIL. Paraná, Tibagí, Guartelá, corticolous in cerrado, 20.xi.1993, *S. Eliasaro 1107, 1108, 1109a* (UPCB 28706, 28707, 28708); Ponta Grossa, beira de BR, near Vila Velha, on sandstone, 21.i.1996, *S. Eliasaro 1547* (UPCB 28735, BAFC 28735), *1555, 1556* (UPCB

28744, 28745). UNITED STATES OF AMERICA. Georgia, Rockdale Co., Mt. Arabia, on conifers, 300 m, iv.1964, *M. E. Hale 30865* (US-holotype).

Although Hale (1972) described this species as being pustulate (without mentioning the soredia originating from pustules), we found that the type of this species has sorediate dactyls. Similarly, Skorepa (1983) did not mention the soredia (of pustular origin) present in the type. Krog & Swinscow (1979) treated the pustulate-sorediate and epustulate-sorediate material as conspecific under the name of *H. immaculata* (Kurok.) Hale. This approach was also followed by Adler & Elix (1992), who identified Argentine specimens with pustules and sorediate pustules, as *H. immaculata*. However, we now believe it more appropriate to treat *H. immaculata* and *H. pustulifera* as distinct taxa, although this problem does require further study on a world-wide basis. The above specimens from Paraná are very similar to the type of *H. pustulifera*, in both morphology and chemistry and so we report *H. pustulifera* for the first time for South America. The detailed medullary chemistry of this species has not been elucidated previously.

This species grows on tree trunks or on standstone in the Segundo Planalto of Paraná.

20. Hypotrachyna silvatica (Lynge) Hale, Smithsonian Contr. Bot. 25: 63 (1975).

Thallus corticolous, pale grey, tightly adnate, 2-3 mm diam. Lobes sublinear, (0.5-) 1-0.8 (-2) mm wide, subdichotomously branched, with truncate apices. Upper surface plane, emaculate. Medulla white in the upper side, reddish-orange in the lower half. Lower surface black, moderately rhizinate, rhizines simple to rarely dichotomously branched. Apothecia common, with crenate margin, sessile, up to 5 mm diam., disc pale brown; ascospores hyaline, ellipsoid, 5-7 x 9.5-12 µm. Pycnidia laminal, immersed, conidia bifusiform, 6-6.5 µm.

Chemistry: Upper cortex K- (lichexanthone, major); medulla K- to slightly K+ yellow in the upper half (protocetraric acid, major; virensic acid, trace), K+ purple in the lower half (pigmentosin B, major).

Specimens examined: BRAZIL. Mato Grosso, Santa Anna da Chapada, *Malme 2393** (S, lectotype of *Parmelia silvatica* Lynge selected by Hale), *Malme* (S, lectotype of *P. crustacea* Lynge selected by Hale), *Malme 2393**** (S, lectotype of *P. silvatica* var. *pinnata* Lynge selected by Hale), *Malme 2393*** (S, lectotype of *P. silvativa* var. *radiata* selected by Hale); Serra da Chapada, Burití, *Malme* (Lichenes Austroamericani 87, S). Paraná, Tibagí, Canion Guartelá, 25°32´S, 50°19´W, 20.ix.1993, *S. Eliasaro 1104* (UPCB 24818); Jaguariaíva, Parque Estadual do Cerrado, 25°32´S, 50°19´W, 16.iv.1994, *S. Eliasaro 1263, 1274* (UPCB 24823, 24821).

H. silvatica, a Brazilian endemic, has previously been recorded from the states of Mato Grosso (Hale 1975), Pará (Brako et al. 1985) and Paraná (Eliasaro & Adler 1997).

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LICHENS AND LICHENICOLOUS FUNGI ON PELTIGERALES IN THE IBERIAN PENINSULA AND THE CANARY ISLANDS

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ABSTRACT: Fifty-eight species of lichens and lichenicolous fungi growing on *Lobaria*, *Peltigera*, *Solorina* and *Sticta* species are reported from the Iberian Peninsula and the Canary Islands. Thirteen taxa are growing on *Lobaria*, forty-three on *Peltigera*, three on *Solorina* and one on *Sticta*. Thirty-one species have been collected for the first time in the Iberian Peninsula, and three species are new records for the Canary Islands.

KEY WORDS: Lichenicolous fungi, lichens, *Lobaria*, *Peltigera*, *Solorina*, *Sticta*, Iberian Peninsula, Canary Islands.

Introduction

Santesson (1960), Werner (1937) and Pitard & Harmand (1911), respectively, were the first to report information about lichenicolous fungi in the Iberian Peninsula and the Canary Islands. Understanding of these fungi was notoriously limited in these territories until the 90's, when many papers were published, e. g. Atienza 1992, Atienza et al. 1993, Azuaga & Gómez-Bolea 1996, Boqueras & Diederich 1993, Boqueras & Gómez-Bolea 1986, Boqueras et al. 1989, Calatayud & Atienza 1995, Calatayud & Barreno 1994, 1995, Calatayud & Rico 1995, Calatayud et al. 1995, Diederich 1996, Etayo 1996a, 1996b, Etayo & Breuss 1996, Etayo & Diederich 1995, 1996a, 1996b, Giralt & Gómez-Bolea 1988, Hafellner 1995a, 1995b, 1995c, 1995d, 1996a, Hafellner & Sancho 1990, Marcos-Laso 1993, Navarro-Rosinés & Hladún 1994, Navarro-Rosinés et al. 1994, Navarro-Rosinés & Roux 1995, Renobales 1996, etc.

Lichenicolous fungi on *Peltigera* have been extensively studied in Europe by Alstrup & Læssøe (1986), Hawksworth (1980a), Hawksworth & Miadlikowska (1997a), Kümmerling & Alstrup (1992) and Miadlikowska & Alstrup (1995), but only seven taxa on *Peltigera* had been reported in the Iberian Peninsula: *Corticifraga peltigerae*, *Fusarium peltigerae*, *Illosporium carneum*, *Libertiella malmedyensis*, *Lichenosticta alcicornaria*, *Rhagadostoma lichenicola* var. *brevisporum* and *Stigmidium peltideae* (Calatayud et al. 1995, Etayo & Diederich 1996a, Navarro-Rosinés & Hladún 1994, Marcos-Laso 1993, Santesson 1960), and three from the Canary Islands: *Arthonia*

fuscopurpurea, *Corticifraga fuckelii* and *C. peltigerae* (Hafellner 1995b, 1996, Hawksworth & Santesson 1990). The main goal of this paper is to improve our knowledge on lichenicolous fungi growing on selected Peltigerales in the Iberian Peninsula and the Canary Islands.

Material and methods

The studied material was mainly collected by the first author (herb. Martínez) from different localities in the Iberian Peninsula, but some material was provided by different colleagues and some additional specimens were separated from collections in LEB (University of León, Spain). Finally, other samples from GZU and herb. Hafellner were considered in the study.

Brief information on the general distribution and the previous references are presented for each species. Some discussion about the morphology and host species is added. Further we include selected references to recent descriptions or sources for nomenclatural information of poorly known species.

In the nomenclature we mostly followed Purvis et al. (1992) and Santesson (1993) for lichens and Clauzade et al. (1989) and Santesson (1993) for lichenicolous fungi, except for recently monographed taxa.

Abrothallus welwitschii Mont. ex Tul.
Ref.: Clauzade et al. (1989: 24).

A. welwitschii is known from Portugal, British Isles (Clauzade et al. 1989: 24), Norway (Holien & Tønsberg 1994: 69, Santesson 1993: 7), Sweden (Santesson 1993: 7), and North America (Goward & Thor 1992: 33). It has previously been reported from the Canary Islands by Calatayud & Barreno (1995: 399), Etayo (1996b: 94), Hafellner (1995a: 135), Santesson (1994: 2) and Steiner (1904: 406, as *A. parmeliarum*).

Studied material: **SPAIN**: Canary Islands, **La Gomera**: La Montañeta E ober El Cedro, am Höhenrücken SW vom Gipfel, ca. 1020 m, 28°07'30"N/17°12'W; Erica-Buschwald mit Stockausschlag von *Laurus*, auf Zweigen von *Laurus*, on *Sticta limbata*, 18-II-1991, J. Hafellner 32832 & A. Hafellner (herb. Hafellner). **El Hierro**: auf dem zentralen Bergrücken NE der Hoya de Fileba, ca. 1,5 km NE der Abzweigung nach Santuario Virgen de los Reyes, ca. 1330 m, 27°44'30"N/17°59'W; *Pinus*-Forst, auf Stammborke von *Pinus*, on *Sticta fuliginosa*, 7-II-1995, J. Hafellner 43924 (herb Hafellner), 43914 (GZU). **Tenerife**: Anaga, 850 m, on *Sticta limbata*, on *Erica arborea*, 23-IX-1993, A. Terrón (LEB); Macizo de Anaga, Monte de las Mercedes, bei der Abzweigung nach El Moquinal NE ober Las Mercedes, ca. 880 m, 28°31'30"N/16°17'W; Lorbeerwald; an Stämmen von Laubbäumen, on *Sticta fuliginosa*, 8-II-1989, J. Hafellner 32837 & A. Hafellner (herb. Hafellner).

Agonimia tristicula (Nyl.) Zahlbr.
Ref.: Purvis (1992a: 67).

This lichen has been reported on *Collema* species, on soil and mosses and rarely on bark from the British Isles, continental Europe and the Azores (Purvis 1992a: 67), but this species can also grow on other lichens (Etayo, pers. comm.). In the Iberian Peninsula it was known from Asturias (Boom & Gómez-Bolea 1991: 499), Gerona (Navarro-Rosinés & Hladún 1990: 77), Jaén (Boom & Gómez-Bolea 1991: 499), La Rioja (Etayo & Breuss 1996: 224), Málaga (Seaward 1983: 332), Navarra (Etayo & Breuss 1996: 224) and Vizcaya (Renobales 1996: 48, Renobales & Barreno 1989: 396).

Studied material: **SPAIN**: **Cuenca**: Tragacete, Sierra de Tragacete, río Júcar, 30TWK9971, 1600 m, on *Peltigera rufescens*, on calcareous rocks, 29-V-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1433). **Madrid**: El Escorial, la Herrería, 30TVK09, on *P. canina*, on *Quercus pyrenaica*, 6-V-1996, G. Aragón & I. Martínez (herb. Martínez 1432); Puebla de la Sierra, 30TVL6240, 1200 m, on *P. collina*, on *Q. pyrenaica*, 8-XII-1994, A. Pujol (herb. Martínez 1307). **Lérida**: Montellá, Sierra del Cadí, refugio de Prat d'Aguiló, 31TCG9484, 1800 m, on *P. rufescens*, on granitic rocks, 2-VII-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1306).

Arthonia fuscopurpurea (Tul.) R. Sant.
Ref.: Coppins (1992a: 81).

The species has previously been recorded from the British Isles (Watson 1948: 308; Hawksworth 1983a: 21; Rondon 1968-69: 738), continental Europe (Brand et al. 1988: 18; Degelius 1982: 46; Goffinet et al. 1994: 200; Grelet 1956: 35; Hoffmann et al. 1991: 229; Holien & Tønsberg 1994: 69; Lettau 1958: 140; Räsanen 1939: 186; Santesson 1986: 11; Vezda 1963: 150; Vouaux 1914: 161; Watson 1948: 308; Wirth 1994: 5; Wittmann & Türk 1994: 190; Zhurbenko 1996: 224), the Canary Islands (Hafellner 1995a: 137), Faroes (Alstrup et al. 1994: 81), Greenland (Alstrup 1981: 121; Alstrup & Hawksworth 1990: 17), Iceland (Orange 1990: 37) and New Zealand (Kondratyuk & Galloway 1994: 26), but some of the records need to be checked. New species for the Iberian Peninsula.

Studied material: **SPAIN**: **Santander**: Vega de Liébana, Porcieda, 30TUN6876, 680 m, on *Peltigera hymenina*, *Quercus suber* forest, 6-VI-1994, A. R. Burgaz (herb. Martínez 1269); Ruberdiajo, 30TUN9771, 1000 m, on *P. hymenina*, on rocks, 5-VIII-1995, E. Ortega & P. Navarro (herb. Martínez 1270); Comunidad de Campoo de Cabuérniga, río Saja, Canal del Infierno, 30TUN9372, 1000 m, on *P. hymenina*, on quarzitic slopes, 29-VI-1996, G. Aragón & I. Martínez (herb. Martínez 1268).

Arthonia muscigena Th. Fr.
(Syn. *A. leucodontis* (Poelt & Döbbeler) Coppins, *Bryostigma leucodontis* Poelt & Döbbeler).
Ref.: Poelt & Döbbeler (1979: 212), Coppins (1992a: 84).

This lichenized fungus is known from the British Isles, continental Europe and North America growing on twigs, tree trunks, bryophytes and shaded rocks (Coppins 1992a: 84; Esslinger & Egan 1995: 472). Arnold (1876: 387) collected one specimen of *Coniangium körberi* Lahm on *Peltigera* thallus and this specimen could belong to *Arthonia muscigena*. In Spain it is known from Navarra, growing on bryophytes, *Bacidia arceutina* and *Fagus sylvatica* (Boom et al. 1995: 267).

Studied material: **SPAIN**: **Lérida**: Pirineos, Espot, río Peguera, 31TCH4114, 1800 m, on *Peltigera polydactylon*, on slopes, 12-VII-1994, G. Aragón, J. Castillo, A. Herrero & I. Martínez (herb. Martínez 1271).

Bacidia bagliettoana (A. Massal. & De Not.) Jatta
Ref.: Coppins (1992b: 111).

B. bagliettoana is known from the British Isles, continental Europe and North America and as it is lichenized, it usually grows on mosses and plant debris on calcareous rocks (Coppins 1992b: 111). The species is widely distributed in the Iberian Peninsula.

Studied material: **SPAIN**: **Albacete**: Villaverde de Guadalimar, pico de la Sarga, 30SWH4162, 1700 m, on *Peltigera. rufescens*, on calcareous rocks, 28-VII-1995, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1379). **Lérida**: Montellá, Sierra del Cadí, refugio de Prat d'Aguiló, 31TCG9484, 1800 m, on *P. rufescens*, on granitic rocks, 2-VII-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1378). **Málaga**: Parauta, Sierra de las Nieves, 30SUF1860, 1050 m, on *P praetextata*, on calcareous rocks, 20-III-1995, G. Aragón & I. Martínez (herb. Martínez 1376). **Teruel**: Tramacastilla, Sierra de Albarracín, río Guadalaviar, 30TXK2076, 1300 m, on *Peltigera* sp., on calcareous rocks, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1377).

Bacidia herbarum (Stizenb.) Arnold
Ref.: Coppins (1992b: 111).

This lichen is widespread in the British Isles, continental Europe and North America on similar substrata to *B. bagliettoana* (Coppins 1992b: 111). Arnold (1874: 83) reported the species from Austria growing on *Cladonia cariosa*. In Spain, this species is only known from Navarra (Etayo, in press).

Studied material: **SPAIN**: **Teruel**: Noguera, Sierra de Albarracín, barranco de los Polos o de las Fuentes, 30TXK1776, 1550 m, on *Peltigera neckeri*, on calcareous slopes, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1380).

Biatora carneoalbida (Müll. Arg.) Coppins
Ref.: Coppins (1992c: 120).

B. carneoalbida usually grows over mosses and it is known from Scotland, Scandinavia, C. & S. Europe and Canada (Coppins 1992c: 120). In Spain it has previously been reported from Orense (Carballal & López de Silanes 1992: 92).

Studied material: **SPAIN**: **Lérida**: Pirineos, Valls de Valira, Ars, 31TCH6700, 1500 m, on *Peltigera rufescens*, on calcareous slopes, 1-VII-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1381).

Biatora vernalis (L.) Fr.
Ref.: Printzen (1995: 146).

This widely distributed lichen is known from Scandinavia to northern Spain (Printzen 1995: 146) and also from the British Isles (Coppins 1992c: 121). *B. vernalis* has already been reported on *Peltigera* thallus by Arnold (1874: 83). In Spain it is known from Asturias (Printzen 1995: 147), Cádiz (Colmeiro 1889: 837), Galicia (Carballal et al. 1995: 58), León (Terrón et al. 1992: 27), Navarra (Printzen 1995: 147), Segovia (Martínez & Aragón 1996: 146) and Sevilla (González Fragoso 1883: 403).

Studied material: **SPAIN**: **Cuenca**: Tragacete, Sierra de Tragacete, río Júcar, 30TWK9971, 1600 m, on *Peltigera rufescens*, on calcareous rocks, 29-V-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1437).

Bispora christiansenii D. Hawksw.
Ref.: Hawksworth (1979: 207).

This lichenicolous hyphomycete is a parasite of many lichen species, but this is the first collection on *Lobaria amplissima*. It is widely distributed in the British Isles (Hawksworth 1979: 207, 1983a: 32), continental Europe (Alstrup 1991: 65; Alstrup et al. 1992: 128; Aptroot & Alstrup 1991: 74; Boom 1992: 96; Boom et al. 1994a: 168; Bricaud et al. 1991: 143; Bricaud & Roux 1990: 120, 1994: 122; Christensen et al. 1991: 100, 1995: 88; Diederich 1986: 17, 1989: 237; Faltynowicz 1993: 6; Giersberg et al. 1992: 124; Hafellner 1994b: 3; Hafellner & Maurer 1994: 116; Hawksworth 1979: 207, 1992: 99; Roux & Egea 1992: 108; Wirth 1994: 7,), Córcega (Hafellner 1994a: 221) and Greenland (Alstrup & Hawksworth 1990: 19; Alstrup & Olech 1993: 35). In Spain and Canary Islands, *B. christiansenii* is known from many localities (Calatayud et al. 1995: 369; Diederich 1986: 18; Giralt & Gómez-Bolea 1988: 198; Hafellner 1996a: 2; Navarro-Rosinés & Roux 1994: 259).

Studied material: **SPAIN**: **Santander**, Comunidad de Campoo de Cabuérniga, río Saja, Canal del Infierno, 30TUN9372, 1000 m, on *Lobaria amplissima*, on *Fagus sylvatica*, 28-VI-1996, G. Aragón & I. Martínez (herb. Martínez 1396).

Caloplaca cerina (Ehrh. ex Hedw.) Th. Fr.
Ref.: Laundon (1992: 147).

This lichen is known from the British Isles, continental Europe and North America and usually grows on bark, mosses and other different taxa on plant debris over basic rocks (Laundon 1992: 147). Arnold (1874: 83) reported this species growing on a *Peltigera* thallus. *C. cerina* is widely distributed in the Iberian Peninsula.

Studied material: **SPAIN**: **Málaga**: Parauta, Sierra de las Nieves, 30SUF1459, 950 m, on *Peltigera rufescens*, on calcareous rocks, 18-III-1995, G. Aragón & I. Martínez (herb. Martínez 1333).

Capronia peltigerae (Fuckel) D. Hawksw.
(syn. *Herpotrichiella peltigerae* (Fuckel) D. Hawksw.)
Ref.: Hawksworth (1980a: 371).

C. peltigerae is known from Europe (Bouly de Lesdain 1910: 276; Diederich et al. 1988: 33; Diederich et al. 1991: 16; Eriksson 1992: 24; Goffinet et al. 1994: 200; Hafellner 1994b: 4; Hawksworth 1990: 397; Kondratyuk et al. 1996: 236; Miadlikowska & Alstrup 1995: 8; Santesson 1993: 51; Vitikainen 1991: 37), and Greenland (Alstrup & Hawksworth 1990: 21). New for the Iberian Peninsula.

Studied material: **SPAIN**: **Guadalajara**: Orea, Cerro de la Muela, 30TXK1089, 1600 m, on *Peltigera rufescens*, on calcareous rocks, 19-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1431). **Jaén**: Segura de la Sierra, Sierra de Segura, Pontones, 30SWH3030, 1500 m, on *P. rufescens*, on calcareous rocks, 22-III-1995, G. Aragón & I. Martínez (herb. Martínez 1382). **Lérida**: La Coma i la Pedra, Tuixén, 31TCG8170, 1750 m, on *P. rufescens*, on calcareous rocks, 4-VII-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1384). **Málaga**: Parauta, Sierra de las Nieves, 30SUF1459, 950 m, on *P. rufescens*, on calcareous rocks, 18-III-1995, G. Aragón & I. Martínez (herb. Martínez 1391). **La Rioja**: Sierra Cebollera, puerto Piqueras, 30TWM35, 1370 m, on *P. britannica*, on slopes, 29-VII-1996, N. Marcos & P. Navarro (herb. Martínez 1383). **Segovia**: Puerto de Navacerrada, río Eresma, 30TVL11, 1450 m, on *P. britannica*, *Pinus sylvestris* forest, 3-IV-1993, A. Buades (herb. Martínez 1385). **Teruel**: Noguera, Sierra de Albarracín, barranco de los Polos o de las Fuentes, 30TXK1776, 1550 m, on *P. canina*, on calcareous slopes, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1389); Ibidem, on *P. rufescens* (herb. Martínez 1388); Ibidem, on *P. neckeri* (herb. Martínez 1429); Orihuela del Tremedal, Sierra de Albarracín, arroyo Gargantavellanos, 30TXK1188, 1540 m, on *P. canina*, on quarzitic rocks, 19-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1386); Ibidem, on *P. rufescens* (herb. Martínez 1387); Tramacastilla, Sierra de Albarracín, río Guadalaviar, 30TXK2076, 1300 m, on *P. rufescens*, on calcareous rocks, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1390).

Catillaria nigroclavata (Nyl.) Schuler
Ref.: Kilias (1981: 293).

This lichen is widely distributed in the British Isles, continental Europe and North America growing on trees (Coppins 1992d: 168) or wood (Santesson 1993: 54). *C. nigroclavata* has also been collected on several lichens, including *Melanelia glabra*, *Pannaria rubiginosa*, *Parmelia carporrhizans*, *Pertusaria* sp. and *Peltigera horizontalis* (Etayo pers. comm.; Hafellner 1994a: 222; Rambold & Triebel 1992: 105; Roux 1992: 105). The species is widely distributed in the Iberian Peninsula.

Studied material: **SPAIN**: Canary Islands, **Gran Canaria**: Pinar de Tamadaba NW von Artenara, NW-Hänge kurz NW unter den Casas de Tamadaba, ca. 1200 m, 28°03'30"N/15°41'W; Kiefernwald, auf Stammborke von *Pinus canariensis*, on *Lobaria scrobiculata*, 25-II-1994, J. Hafellner 43918 (GZU). **Toledo**: Navalucillos, Montes de Toledo, arroyo del Chorro, 30SUJ5879, 1000 m, on *Peltigera canina*, on quarzitic rocks, 26-III-1995, G. Aragón & I. Martínez (herb. Martínez 1334).

Cornutispora lichenicola D. Hawksw. & B. Sutton
Ref.: Hawksworth (1976: 51).

This slightly parasitic coelomycete is widely distributed on several hosts in the British Isles, continental Europe, Africa, Australia, and North America (Kalb et al. 1995: 203). In Spain and the Canary Islands it is known from many localities (Álvarez & Carballal 1992: 362; Calatayud et al. 1995: 370; Diederich 1986: 19; Etayo & Diederich 1996a: 98; Giralt & Gómez-Bolea 1988: 196; Hafellner 1995a: 430; Navarro-Rosinés et al. 1994: 195).

Studied material: **SPAIN**: **León**: Puerto de Ancares, 29TPH84, 1500 m, on *Lobaria pulmonaria*, on *Ilex aquifolium*, 11-IX-1988, A. Terrón (LEB 917).

Corticifraga fuckelii (Rehm) D. Hawksw. & R. Sant.
(Syn. *Phragmonaevia fuckelii* Rehm).
Ref.: Hawksworth & Santesson (1990: 125).

C. fuckelii is widely distributed in Africa, Europe, North and South America, always in cool-temperate areas (Hawksworth & Santesson 1990: 126). In the material from the Málaga province it grows together with *Hawksworthiana peltigericola* and the specimen from Tenerife together with *Refractohilum peltigerae.* This is the first time that *C. fuckelii* is reported from the Iberian Peninsula, but it was already known from Tenerife (Hafellner 1996a: 3).

Studied material: **SPAIN**: Canary Islands, **Tenerife**: Macizo de Anaga, Vueltas de Taganana N über dem Forsthaus an der Straße von Las Mercedes nach El Bailadero, 28° 32' 32" N/ 16° 13' 45" W, ca. 820 m, on *Peltigera hymenina*, degradierter Lorbeerwald an steilem N-Hang, 19-XII-1994, J. Hafellner 33755 (herb. Hafellner, sub *Refractohilum peltigerae*). **Málaga**: Parautas, Sierra de Tolox, 30SUF1959, 950 m, on

P. praetextata, on calcareous soil, 20-III-1995, G. Aragón & I. Martínez (herb. Martínez 1256).

Corticifraga peltigerae (Nyl.) D. Hawksw. & R. Sant.
(Syn. *Phragmonaevia peltigerae* (Nyl.) Rehm).
Ref.: Hawksworth & Santesson (1990: 129).

The parasitic *C. peltigerae* is widely distributed, growing on *Peltigera* species and *Solorina crocea* (Hawksworth & Santesson 1990: 130, 132). Although these authors and also Kümmerling & Alstrup (1992: 120) underlined that *C. peltigerae* seems to have a much more restricted distribution than *C. fuckelii*, *C. peltigerae* is the most common species of the genus in Spain. Previously reported from Spain in Asturias (Santesson 1960: 516), Castellón (Calatayud et al. 1995: 370), and in Salamanca (Marcos-Laso 1993: 156).

Studied material: **SPAIN**: **Asturias**: Somiedo, Villar de Vildas, 29TQH1673, 940 m, on *Peltigera canina*, on soil, 1-XI-1993, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1238); Ibidem, 29TQH1773, 1000 m, on *P. rufescens* (herb. Martínez 1239); Somiedo, Valle de Lago, 29TQH27, 1500 m, on *P. rufescens*, on rocks, 31-X-1993, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1241); Picos de Europa, Amieva, río Dobra, 30TUN3487, 1150 m, on *P. rufescens*, on calcareous rocks, 15-X-1995, G. Aragón & A. Herrero (herb. Martínez 1242). **Ávila**: Candeleda, Sierra de Gredos, río Santa María, 30TUK0951, on *P. canina*, on granitic rocks, 19-III-1993, G. Aragón, J. Castillo, A. Herrero & I. Martínez (herb. Martínez 1237). **Burgos**: Valdenoceda, río Ebro, 30TVN54, on *P. rufescens*, on calcareous rocks, 23-III-1994, A. Herrero (herb. Martínez 1246). **Cáceres**: Villar del Pedroso, Garganta del Mesta, 30SUJ0285, 600 m, on *P. canina*, *Quercus pyrenaica* forest, 4-I-1995, G. Aragón & I. Martínez (herb. Martínez 1250); Ibidem, on *P. praetextata* (herb. Martínez 1249); Garganta la Olla, arroyo Majaelbrera, 30TTK6043, 1100 m, on *P. rufescens*, on granitic rocks, 2-VI-1993, G. Aragón & J. Castillo (herb. Martínez 1248); Ibidem, on *P. canina* (herb. Martínez 1247). **Guadalajara**: Yélamos de Abajo, río San Andrés, 30TWK1097, 900 m, on *P. rufescens*, on calcareous rocks, 28-V-1993, G. Aragón & I. Martínez (herb. Martínez 1251). **Jaén**: Valdeazores, Despeñaperros, 30SVH55, 660 m, on quarzitics, *Q. ilex* ssp. *ballota* forest, 15-XI-1993, A. R. Burgaz (herb. Martínez 107). **Madrid**: Rascafría, puerto de la Morcuera, 30TVL22, 1350 m, on *P. rufescens*, on acid slopes, 4-IV-1993, G. Aragón & I. Martínez (herb. Martínez 1253); Somosierra, Dehesa Boyal, on *P. collina*, on *Q. pyrenaica*, 7-V-1992, A. R. Burgaz (herb. Martínez 1254). **Santander**: Camaleño, Invernales de Mato, 30TUN5574, 950 m, on *P. degenii*, on *Fagus sylvatica*, 8-VI-1994, A. R. Burgaz (herb. Martínez 1252). **Soria**: Montejo de Tormes, Torresuso, 30TVL8477, 1200 m, on *P. rufescens*, on sandstones, 4-XI-1995, G. Aragón & A. Herrero (herb. Martínez 1244); San Esteban de Gormaz, Torremocha de Ayllón, 30TVL8187, 1000 m, on *P. rufescens*, on calcareous soil, 4-XI-1995, G. Aragón & A. Herrero (herb. Martínez 1243). **Toledo**: Hontanar, Montes de Toledo, 800 m, on *P. collina*, on *Q. pyrenaica*, 11-V-1992, A. R. Burgaz (herb. Martínez 1255); Almendral de la Cañada, Sierra de San Vicente, 30TUK5249, 1100 m, on *P. neckeri*, on acid slopes, 25-V-1995, A. R. Burgaz (herb. Martínez 1245).

Dacampia engeliana (Saut.) A. Massal.
(Syn. *Pleospora engeliana* (Saut.) G. Winter).
Ref.: Henssen 1995: 154.

The pyrenomycete is widely distributed in Europe (Arnold 1869: 638, 1871: 1145, 1872: 149, 1875: 346, 1887: 133; Boom et al. 1993: 35; Bricaud & Roux 1990: 124; Hafellner & Türk 1995: 609; Hafellner & Wittmann 1996: 9, 12; Lettau 1958: 162; Mayrhofer et al. 1989: 224; Nimis 1993: 269; Obermayer 1993: 142; Rondon 1968-69: 713; Santesson 1993: 171, 1994: 16; Vouaux 1913: 122; Zhurbenko & Santesson 1996: 152, etc), although rarely collected in Spain. There it was sofar known only from Navarra (herb. J. Etayo 11232, 11579) and Tarragona (Navarro-Rosinés et al. 1994: 172).

Studied material: **SPAIN**: **Asturias**: Picos de Europa, Amieva, río Dobra, 30TUN3487, 1150 m, on *Solorina saccata*, on calcareous rocks, 15-X-1995, G. Aragón & A. Herrero (herb. Martínez 1404). **Cuenca**: Sierra de Tragacete, Tragacete, río Júcar, 30TWK9971, 1600 m, on *S. saccata*, on calcareous rocks, 29-V-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1403). **Soria**: Montejo de Tiermes, Torresuso, arroyo de Montejo, 30TVL8477, 1200 m, *S. saccata*, on red sandstones, G. Aragón & A. Herrero (herb. Martínez 1402).

Dacampia rufescentis (Vouaux) D. Hawksw.
(Syn. *Pleospora rufescentis* Vouaux).
Ref.: Hawksworth (1986: 497).

D. rufescentis is known from the British Isles (Hawksworth 1986: 497), continental Europe (Bouly de Lesdain 1914: 163; Eriksson 1992: 32; Keissler 1930: 19; Rondon 1968-1969: 713; Santesson 1986: 3; Vouaux 1913: 124) and Argentina (Wedin 1994: 308), and is reported here for the first time from the Iberian Peninsula.

Studied material: **SPAIN**: **Alicante**: Alcoy, Sierra de Menechaor, Font Roja, 30SYH1382, 1200 m, on *Peltigera rufescens*, on calcareous slopes, 27-V-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1313). **Asturias**: Torrebarrio, puerto de Ventana, 30TQH46, 1685 m, on *P. rufescens*, on calcareous rocks, 25-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1317); Páramo, río Teverga, 30TQH47, 1400 m, on *P. praetextata*, on acid rocks, 25-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1316). **Jaén**: Sierra Morena, Aldeaquemada, La Cimbarra, 30SWH6749, 700 m, on *P. canina*, on *Quercus ilex* ssp. *ballota*, 14-II-1993, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1312). **León**: Villablino, Rioscuro, 30TQH2256, 1450 m, on *P. praetextata*, on slopes, 24-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1314). **Málaga**: Estepona, Sierra Bermeja, Los Reales, 30SUF0240, 1350 m, on *P. praetextata*, on serpentines, 16-IV-1995, A. Herrero (herb. Martínez 1319); Ronda, Sierra de las Nieves, 30SUF1862, 1600 m, on *P. ponojensis*, on calcareous rocks, 18-III-1995, G. Aragón & I. Martínez (herb. Martínez 1318). **Teruel**: Noguera, Sierra de Albarracín, barranco de los Polos o de las Fuentes, 30TXK1776, 1550 m, on *P. canina*, on calcareous slopes, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez

1310); Ibidem, on *P. rufescens* (herb. Martínez 1309); Albarracín, Sierra de Albarracín, barranco del Navazo, 30TXK3473, 1200 m, on *P. canina*, on sandstones, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1311).

Dactylospora lobariella (Nyl.) Hafellner
Ref.: Hafellner (1979: 118).

The species is known from the British Isles (Hawksworth 1975: 183, 1983a: 18; Vezda 1980: 7), continental Europe (Etayo & Diederich 1996a: 98; Karstrom & Thor 1991: 88; Keissler 1924: 164; Santesson 1993: 76, 1994: 4; Türk & Breuss 1994: 86; Wittmann & Türk 1989: 192; etc), New Zealand (Kondratyuk & Galloway 1994: 27), North America (Bouly de Lesdain 1922: 23; Egan 1987: 103; Goward et al. 1994: 57; Hafellner 1979: 120), South America (Hafellner 1979: 120) and South Africa (Keissler 1933: 380). In the studied area *D. lobariella* was already recorded from the Canary Islands (Etayo 1996b: 101; Hawksworth 1982a: 83), and the Spanish Pyrenees (Etayo & Breuss 1996: 225; Etayo & Diederich 1996a: 98).

Studied material: **SPAIN**: Canary Islands, **La Gomera**: Bosque del Cedro, on *Lobaria pulmonaria*, 4-I-1990, A. R. Burgaz (herb. Martínez 1406). **León**: Campo del Agua, 29TPH73, 870 m, on *L. amplissima*, on *Quercus x rosacea*, 23-VII-1990, A. Terrón, (LEB 2300); Priaranza del Bierzo, 29TPH9108, 650 m, on *L. amplissima*, on *Castanea sativa*, 7-V-1984, A. Terrón (LEB 2571); Picos de Europa, Posada de Valdeón, 30TUN4178, 1025 m, on *L. amplissima*, on *Fagus sylvatica*, 5-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1412). **Santander**: Comunidad de Campoo de Cabuérniga, río Saja, 30TUN9372, 850 m, on *L. amplissima*, on quarzitic slopes, 18-VI-1996, G. Aragón & I. Martínez (herb. Martínez 1464).

Graphium aphthosae Alstrup & D. Hawksw.
Ref.: Alstrup & Hawksworth (1990: 37).

G. aphthosae usually grows on *Peltigera aphthosa*, but in the Iberian Peninsula frequently appears on other *Peltigera* species. This lichenicolous fungus has been reported from Austria (Hafellner 1994b: 10; Hafellner & Türk 1995: 614), Denmark (Alstrup 1993: 63), Norway and Sweden (Alstrup & Hawksworth 1990: 38; Kümmerling & Alstrup 1992: 120; Santesson 1993: 87; Thor 1992: 23), Russia (Zhurbenko & Santesson 1996: 154), Greenland (Alstrup & Hawksworth 1990: 38) and North America (Esslinger & Egan 1995: 493). It is a new species for the flora of the Iberian Peninsula.

Studied material: **ANDORRA**: Les Escaldes-Engordany, collado de Jovell, 31TCH80, 1600 m, on *Peltigera elisabethae*, on acid rocks, 6-XII-1994, A. Herrero (herb. Martínez 1328). **SPAIN**: **Burgos**: Huidobro, 30TVN43, on *P. membranacea*, on soil, 7-VI-1988, A. R. Burgaz (herb. Martínez 1329). **Cuenca**: Valdemeca, Sierra de Valdemeca, 30TXK0748, 1400 m, on *P. membranacea*, on calcareous slopes, 29-V-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1425). **Huesca**: Pirineos, Panticosa, barranco del Brazato, 30TYN2737, 1900-2100 m, on *P. rufescens*, on acid slopes, A. R.

Burgaz & I. Martínez (herb. Martínez 1327). **Lérida**: Pirineos, Barruera, collado de Dellui, 31TCH3114, 2000 m, on *P. aphthosa*, on soil, 10-VII-1994, G. Aragón, J. Castillo, A. Herrero & I. Martínez (herb. Martínez 1326).

Hawksworthiana peltigericola (D. Hawksw.) U. Braun
(Syn. *Ramularia peltigericola* D. Hawksw.)
Ref.: Hawksworth (1980b: 172), Braun (1988: 276).

This hyphomycete is known from the British Isles (Braun 1995: 280; Hawksworth 1980b: 172, 1983a: 31; Watling 1985: 27), Luxembourg (Diederich et al. 1988: 29; Goffinet et al. 1994: 200), Sweden (Santesson 1993: 90) and North America (Goward et al. 1994: 57). It is recorded herewith for the first time for the Iberian Peninsula.

Studied material: **SPAIN**: **Málaga**: Parautas, Sierra de Tolox, 30SUF1959, 950 m, on *Peltigera praetextata*, on calcareous soil, 20-III-1995, G. Aragón & I. Martínez (herb. Martínez 1424).

Illosporium carneum Fr.
Ref.: Hawksworth (1979: 232).

This species is known from the British Isles (Hitch 1995: 40; Hawksworth 1979: 235, 1983a: 31; Watson 1948: 329), continental Europe (Boom et al. 1993: 36; Brand et al. 1988: 34; Diederich et al. 1988: 33; Faltynowicz 1993: 16; Goffinet et al. 1994: 200; Hafellner & Türk 1995: 615; Hafellner & Wittmann 1996: 11; Hawksworth 1979: 235; Hoffmann et al. 1991: 231; Kümmerling & Alstrup 1992: 120; Lettau 1912: 257, 1918: 171, 1958: 170; Magnusson 1945: 143; Miadlikowska & Alstrup 1995: 8; Øvstedal 1986: 25; Rondon 1968-69: 740; Santesson 1984: 6, 1993: 94; Tibell 1988: 14; Vezda 1963: 159; Vouaux 1914: 317; Wirth 1994: 12; Zhurbenko 1996: 12; Zhurbenko & Santesson 1996: 154), Iceland (Orange 1990: 40), North America (Goffinet 1994: 2; Goward et al. 1994: 58; Hawksworth 1979: 235; Zhurbenko et al. 1995: 95) and Greenland (Alstrup & Hawksworth 1990: 38; Egan 1991: 397 refers to Alstrup & Hawksworth 1990). In Spain, it was known from Asturias (Santesson 1960: 521).

Studied material: **SPAIN**: **Asturias**: Somiedo, Villar de Vildas, río Pigüeña, 29TQH1673, 1000 m, on *Peltigera rufescens*, on slates, 1-XI-1993, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1240). **Segovia**: Cedillo de la Torre, Umbría de la Hoz, 30TVL4686, 1100 m, on *P. rufescens*, on calcareous soil, 28-XI-1993, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1267). **Teruel**: Tramacastilla, Sierra de Albarracín, río Guadalaviar, 30TXK2076, 1300 m, on *P. rufescens*, on calcareous rocks, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1308).

Karsteniomyces peltigerae (P. Karst.) D. Hawksw.
Ref.: Hawksworth (1981: 22), Triebel et al. (1997: 335).

In the studied material this coelomycete, representing the macroconidial state of *Scutula miliaris*, is never mixed with apothecia of its teleomorph. The species is known from

Austria (Triebel et al. 1997: 336), Czech Republic (Triebel et al. 1997: 336), Finland (Hawksworth 1980a: 371, 1981: 25, Triebel et al. 1997: 336), France (Triebel et al. 1997: 336), Germany (Hawksworth & Diederich 1991: 86; Lettau 1958: 167; Wirth 1994: 13, Triebel et al. 1997: 336), Norway (Hawksworth 1980a: 371, 1981: 25; Santesson 1993: 95), Poland (Lettau 1958: 167; Miadlikowska & Alstrup 1995: 9), Switzerland (Lettau 1958: 167) and Sweden (Santesson 1949: 142, 1984: 7, 1988: 12, 1993: 95). New species for the Iberian Peninsula.

Studied material: **SPAIN**: **Asturias**: Somiedo, puerto de Somiedo, 29TQH26, 1450 m, on *P. rufescens*, on calcareous rocks, 25-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1358). **Cáceres**: San Martín de Trevejo, Sierra de Gata, río de la Vega, 29TPE8856, 800 m, on *P. neckeri*, on granitic rocks, 4-IV-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1426). **Ciudad Real**: Fuencaliente, Garganta los Pozuelos, 30SUH8058, on *P. neckeri*, *Quercus faginea* forest, 14-II-1996, F. J. Sarrión (herb. Martínez 1142). **Zaragoza**: Cariñena, Sierra Algaisen, 30TXL38, 830 m, on *P. neckeri*, 26-VI-1992, A. R. Burgaz (herb. Martínez 1359).

Lasiosphaeriopsis salisburyi D. Hawksw. & Sivan.
Ref.: Hawksworth (1980a: 373).

This species was known only from the British Isles (Eriksson & Santesson 1986: 575; Hawksworth 1980a: 373, 1983a: 7) and the Faroes (Alstrup et al. 1994: 70). It is recorded here for the first time for the Iberian Peninsula.

Studied material: SPAIN: **Guadalajara**: Yélamos de Abajo, río San Andrés, 30TWK1097, 900 m, on *Peltigera rufescens*, on calcareous rocks, 28-V-1993, G. Aragón & I. Martínez (herb. Martínez 1285). **Huesca**: Pirineos, Bielsa, valle de Pineta, río La Larri, 31TBH6029, 1300 m, on *P. didactyla* var. *didactyla*, on acid rocks, 26-VII-1993, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1286). **Toledo**: Navalucillos, Montes de Toledo, arroyo del Chorro, 30SUJ5979, 1000 m, on *P. hymenina*, on acid soil, 2-IV-1995, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1287).

Leptosphaerulina peltigerae (Fuckel) Riedel
(Syn. *Pleospora peltigerae* Fuckel).
Ref.: Hawksworth (1980a: 376).

This species is known from Austria (Keissler 1933: 393), Germany (Hawksworth 1980a: 376; Wirth 1994: 15), the Netherlands (Brand et al. 1988: 38), Scotland (Hawksworth 1990: 398), Switzerland (Lettau 1958: 162), Sweden (Eriksson 1992: 57; Santesson 1949: 142, 1993: 129), Canada (Miadlikowska & Alstrup 1995: 9) and New Guinea (Aptroot et al. 1997: 81). In Spain, this species is also known from Navarra (Etayo , in press).

Studied material: **SPAIN**: **Teruel**: Albarracín, Sierra de Albarracín, barranco del Navazo, 30TXK3473, 1200 m, on *Peltigera neckeri*, on sandstones, 18-V-1996, G.

Aragón, A. Herrero & I. Martínez (herb. Martínez 1264).

Leucocarpia dictyospora (Orange) R. Sant.
(Syn. *Macentina dictyospora* A. Orange).
Ref.: Orange (1991: 16), Kalb & Hafellner (1992: 70).

This lichenized fungus has been described from Sweden (Orange 1991: 16) and this is the first time that is collected on *Peltigera* species, colonizing the oldest parts of the thallus. So far it was known from Sweden (Orange 1991: 16; Santesson 1993: 129) and Switzerland (Dietrich 1991: 473). New species for the Iberian Peninsula.

Studied material: **SPAIN**: **Huesca**: Pirineos, Torla, barranco Lapazosa, 30TYN3731, 1600 m, on *Peltigera rufescens*, on calcareous slopes, 2-X-1995, G. Aragón, J. Castillo, A. Herrero & J. L. Izquierdo (herb. Martínez 1338). **Tarragona**: La Sénia, Reserva de los Puertos de Tortosa y Beceite, fuente del Retaule, 31TBF61, 1100 m, on *P. ponojensis*, on calcareous slopes, 17-III-1996, A. Herrero (herb. Martínez 1337).

Libertiella curvispora Miadlikowska & D. Hawksw.
Ref.: Hawksworth & Miadlikowska (1997b: 1127).

This recently described taxon is characterized by having simple, hyaline, narrowly ellipsoid and curved (4-)5-8 x 1.5-2 µm conidia, whereas *L. malmedyensis* has conidia which are simple, hyaline, ellipsoid to ovoid, (5-)6-8 x (2-)3-4 µm. We have found seven specimens with conidia very similar to *L. curvispora*, curved and 3.8 - 6.4 ± 0.9 - 8.3 µm x 1.11 - 1.8 ± 0.3 - 2.45. Previously, this species was known only from Poland. According to the results presented by Triebel et al. (1997), the species should be a mesoconidial state of a *Scutula* species.

Studied material: **Asturias**: Somiedo, Peral, Fuente de Vega Ventana, 29TQH2468, 1300 m, on *Peltigera praetextata*, on acid rocks, 25-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1296); Picos de Europa, Amieva, río Dobra, 30TUN3487, 1150 m, on *P. horizontalis*, on calcareous rocks, 15-X-1995, G. Aragón & A. Herrero (herb. Martínez 1298). **Burgos**: Berberana, puerto de Orduña, Monte de Santiago, 30TWN0054, 850 m, on *P. horizonzalis*, on *Fagus sylvatica*, 24-VIII-1994, A. Herrero (herb. Martínez 1301). **Cáceres**: San Martín de Trevejo, Sierra de Gata, río de la Vega, 29TPE8856, 800 m, on *P. horizontalis*, on granitic slopes, 4-IV-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1294); Guadalupe, Sierra de Guadalupe, río Guadalupejo, 30STJ96, 600 m, on *P. neckeri*, on rocks, 10-IX-1995, P. Navarro (herb. Martínez 1293). **Madrid**: Lozoya, puerto de Navafría, 30TVL33, 1400 m, on *P. canina*, on acid rocks, 24-II-1994, A. R. Burgaz (herb. Martínez 1291). **Segovia**: Riofrío de Riaza, valle de Riaza, El Llano, 30TVL6465, 1400 m, on *P. membranacea*, on quarzitic rocks, 4-III-1994, I. Martínez (herb. Martínez 1292).

Libertiella malmedyensis Speg. & Roum.
Ref.: Hawksworth (1981: 30), Triebel et al. (1997: 326).

This lichenicolous coelomycete, being the mesoconidial state of a *Scutula* species, usually grows in the oldest areas of the *Peltigera* thallus and sometimes grows together with *Phoma epiparmelia*. It was known from Austria (Berger & Türk 1993: 184), Belgium (Goffinet et al. 1994: 200; Hawksworth 1981: 31), the British Isles (Hawksworth 1982b: 385, 1983a: 29), Denmark (Alstrup & Læssøe 1991: 57; Hertel 1987: 6), France (Vouaux 1914: 300), Poland (Faltynowicz 1993: 21; Hawksworth 1981: 31; Miadlikowska & Alstrup 1995: 9) and Ukraine (Kondratyuk et al. 1996: 258; Miadlikowska 1996: 132). This species was already collected in Spain from Cantabria (herb. J. Etayo 11520) and Valencia (Calatayud et al. 1995: 371).

Studied material: **SPAIN**: **Asturias**: Somiedo, Valle de Lago, 29TQH2872, 1380 m, on *Peltigera rufescens*, on calcareous rocks, 31-X-1993, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1297). **León**: Porcarizas, 29TPH73, 870 m, on *P. praetextata*, on *Salix atrocinerea*, 23-VII-1990, A. Terrón (LEB).

Lichenoconium erodens M. S. Christ. & D. Hawksw.
Ref.: Hawksworth (1977a: 174).

L. erodens, frequent on *Cladonia, Evernia, Hypogymnia, Lecanora, Parmelia, Parmeliopsis and Pertusaria* species has not yet been mentioned on *Lobaria amplissima*. The species is rather common in the British Isles (Hawksworth 1977a: 174, 1983a: 27), Corsica (Hafellner 1994a: 225), continental Europe, the U.S.A. (Hawksworth 1977a: 174, 1981: 35), and South America (Diederich & Christiansen 1994: 59). In Spain it was already mentioned from Cataluña (Giralt & Gómez-Bolea 1988: 196), La Rioja (Etayo & Breuss 1996: 226) and Teruel (Calatayud et al. 1995: 372).

Studied material: **SPAIN**: **Santander**: Comunidad de Campoo de Cabuérniga, río Saja, Canal del Infierno, 30TUN9372, 1000 m, on *Lobaria amplissima*, on *Fagus sylvatica*, 28-VI-1996, G. Aragón & I. Martínez (herb. Martínez 1395).

Lichenopeltella peltigericola (D. Hawksw.) R. Sant.
(Syn. *Actinopeltis peltigericola* D. Hawksw., *Micropeltopsis peltigericola* (D. Hawksw.) P. M. Kirk & Spooner).
Ref.: Hawksworth (1982b: 375), Spooner & Kirk (1990: 228), Santesson (1993: 131).

The fruiting bodies of *L. peltigericola* are usually found on the veins of different *Peltigera* species. So far, it is known from Austria (Hafellner 1994b: 11; Hafellner & Türk 1995: 617; Hoffmann et al. 1995: 232), the British Isles (Hawksworth 1982b: 375, 1983a: 12; Spooner & Kirk 1990: 228), the Netherlands (Boom et al. 1994: 94), Luxembourg (Diederich 1986: 6; Diederich et al. 1988: 33; Diederich et al. 1991: 6; Goffinet et al. 1994: 200), Sweden (Santesson 1984: 3, 1993: 131), Ukraine (Miadlikowska 1996: 132), Cyprus (Hawsworth 1982b: 375, 377), Madeira (Kalb &

Hafellner 1992: 74) and New Guinea (Aptroot et al. 1997: 97). Although this species is very common in the studied area, it is recorded here for the first time for the Iberian Peninsula and the Canary Islands.

Studied material: **ANDORRA**: Les Escaldes-Engordany, collado de Jovell, 31TCH80, 1600 m, on *Peltigera elisabethae*, *Pinus sylvestris* forest, 6-XII-1994, A. Herrero (herb. Martínez 1344). **PORTUGAL**: **Beira Alta**: Sierra de la Estrella, 1100 m, on *P. hymenina*, on acid rocks, A. R. Burgaz & I. Martínez (herb. Martínez 1343). **Minho**: Soajo, río Lima, 29TNG63, 250 m, on *P. hymenina*, on granitic rocks, 17-VI-1995, A. R. Burgaz, I. Martínez & P. Navarro (herb. Martínez 1342); Serra de Peneda, Castro Laboreiro, Bago de Cima, 29TNG65, 750 m, on *P. praetextata*, on granitic rocks, 17-VI-1995, A. R. Burgaz, I. Martínez & P. Navarro (herb. Martínez 1341). **SPAIN**: Canary Islands, **Tenerife**: Santa Cruz de Tenerife, parque forestal de Anaga, carretera de la Laguna al puerto del Bailadero, 28RCS7756, 815 m, on *P. horizontalis*, on rocks, 12-I-1997, L. Medina & L. Ramón-Laca (herb. Martínez 1743). **Asturias**: Ponga, entre Villarcazo y Cazo, Beleño, 30TUN19, 650 m, on *P. membranacea*, on slopes, 3-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1355); Ponga, Priescas, río Ponga, 30TUN19, 400 m, on *P. hymenina*, on quarzitic rocks, 3-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1356). **Ciudad Real**: Fuencaliente, garganta los Pozuelos, 30SUH8058, on *P. praetextata*, *Quercus faginea* forest, 14-II-1996, F. J. Sarrión (herb. Martínez 1347). **La Coruña**: Fraga de Chelo, Ria de Betanzos, on *Peltigera* sp., A. Herrero & J. L. Izquierdo (herb. Martínez 1353). **Huesca**: Pirineos, Canfranc, Canal de Izás, 30TYN03, 1350-1500 m, on *P. kristinssonii*, on calcareous soil, 6-VIII-1993, A. Herrero (herb. Martínez 1351); Pirineos, Ansó, Estrecho de Linza, collado de Artaparreta, on *P. polydactylon*, G. Aragón & I. Martínez (herb. Martínez 1350); Pirineos, Torla, Parque Nacional de Ordesa, 30TYN4026, 1300 m, on *P. elisabethae*, *Fagus sylvatica* forest, 19-VII-1993, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1349); Pirineos, Puértolas, cañón de Añisclo, 31TBH5823, 1800 m, on *P. rufescens*, on calcareous rocks, 21-VII-1993, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1348). **León**: Villablino, Rioscuro, 30TQH2256, 1450 m, on *P. praetextata*, on slopes, 24-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1315). **Lérida**: Montellá, Sierra del Cadí, refugio de Prat d'Aguiló, 31TCG9387, 1600 m, on *P. elisabethae*, on acid soil, 2-VII-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1352); Pirineos, Baqueira, Iglesia de la Plegaria, río Noguera-Pallaresa, 31TCH33, 2000 m, on *P. rufescens*, on slopes, 7-VII-1994, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1340). **Navarra**: Ochagavía, Bosque de Irati, 30TXN5461, 900 m, on *P. membranacea*, on calcareous rocks, 11-IV-1995, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1346). **Segovia**: Montejo de la Vega de la Serrezuela, río Riaza, 30TVL5099, 900 m, on *P. rufescens*, on calcareous slopes, 4-IV-1995, G. Aragón & I. Martínez (herb. Martínez 1345). **Zaragoza**: Sestrica, Sierra de la Virgen, 30TXL19, 750 m, on *P. leucophlebia*, on soil, 26-VI-1992, A. R. Burgaz (herb. Martínez 1339).

Lichenopeltella santessonii (P. M. Kirk & Spooner) R. Sant.
(Syn. *Micropeltopsis santessonii* P. M. Kirk & Spooner).
Ref.: Spooner & Kirk (1990: 228), Santesson (1984: 3, 1993: 131).

This taxon is known from Luxembourg (Diederich 1986: 6 as *Actinopeltis peltigericola;* Diederich et al. 1991: 6; Diederich et al. 1992: 143; Goffinet et al. 1994: 200), Poland (Miadlikowska & Alstrup 1995: 9) and Sweden (Santesson 1984: 3 as *Actinopeltis peltigericola;* Spooner & Kirk 1990: 228). New for the Iberian Peninsula.

Studied material: **SPAIN**: **Huesca**: Canfranc, canal de Izás, 30TYN03, 1350-1500 m, on *Peltigera kristinssonii*, on calcareous rocks, 6-VIII-1993, A. Herrero (herb. Martínez 1744).

Micarea peliocarpa (Anzi) Coppins & R. Sant.
Ref.: Coppins (1983: 169).

M. peliocarpa is a widely distributed species, growing on a wide range of acid substrata (Coppins 1992e: 379). *M. peliocarpa* is also quite common in the Iberian Peninsula, where it grows mainly on decorticated wood.

Studied material: **SPAIN**: **León**: Burbia, 29TPH84, 980 m, on *Lobaria amplissima*, on *Castanea sativa*, 20-XII-1986, A. Terrón (LEB 2581); Puerto de Ancares, 29TPH84, 1500 m, on *L. amplissima*, on *Ilex auifolium*, 11-IX-1988, A. Terrón (LEB 904). **Málaga**: Estepona, Sierra Bermeja, Los Reales, 30SUF0240, 1350 m, on *L. pulmonaria*, on *Abies pinsapo*, 17-III-1995, G. Aragón & I. Martínez (herb. Martínez 1401).

Monodictys fuliginosa Etayo
Ref.: Etayo & Diederich (1996a: 101).

This lichenicolous hyphomycete has recently been described and reported from the French and Spanish Pyrenees (Etayo & Diederich 1996a: 102) and Gomera (Etayo 1996b: 103). In our material *M. fuliginosa* sometimes appears together with *Dactylospora lobariella,* as already Etayo & Diederich (op. cit.) pointed out.

Studied material: **SPAIN**: **León**: Campo del Agua, 29TPH73, 870 m, on *Lobaria amplissima*, on *Quercus x rosacea*, 23-VII-1990, A. Terrón (LEB 2300); Priaranza del Bierzo, 29TPH9108, 650 m, on *L. amplissima*, on *Castanea sativa*, 7-V-1984, A. terrón (LEB 2571); Picos de Europa, Posada de Valdeón, 30TUN4178, 1025 m, on *L. amplissima*, on *Fagus sylvatica*, 5-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1413). **Santander**: Puerto de San Glorio, 30TUN67, 1300 m, on *L. pulmonaria*, on *Q. petraea*, 7-IX-1990, A. Terrón (LEB 1886).

Mycobilimbia sabuletorum (Schreb.) Hafellner
Ref.: Hafellner (1989: 55).

M. sabuletorum has a world-wide distribution and usually grows on mosses or plant debris over calcareous rock, rarely on bark (Coppins 1992b: 114). Arnold (1876: 386) already reported this species growing on *Peltigera* species. *M. sabuletorum* is also quite common in the Iberian Peninsula.

Studied material: **SPAIN**: **Albacete**: Sierra del Calar del Mundo, Ríopar, Cueva de los Chorros, 30SWH4956, 1350 m, on *Peltigera rufescens*, on calcareous rocks, 10-II-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1330). **Cuenca**: Valdemeca, Sierra de Valdemeca, 30TXK0748, 1400 m, on *P. rufescens*, on calcareous slopes, 29-V-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1332). **Guadalajara**: Retiendas, 30TVL73, 800 m, on *P. rufescens*, on calcareous rocks, 1-V-1994, A. Herrero (herb. Martínez 1331).

Norrlinia peltigericola (Nyl.) Theiß. et Syd.
Ref.: Hawksworth (1980a: 378).

This species had been reported from Austria (Berger & Türk 1994: 168), Denmark (Alstrup 1994: 53; Miadlikowska & Alstrup 1995: 9), Finland (Hawksworth 1980a: 378) and Mexico (Keissler 1933: 384). It is a new species for the Iberian Peninsula, appearing only in thermic areas in the south-west.

Studied material: **SPAIN**: **Cáceres**: Garganta la Olla, arroyo Majaelbrera, 30TTK6043, 1100 m, on *Peltigera canina*, on *Quercus pyrenaica*, 2-VI-1993, G. Aragón & J. Castillo (herb. Martínez 1262). **Jaén**: Santiago-Pontones, Sierra de Segura, Hoya del Toro, 30SHW3219, 1740 m, on *P. rufescens*, on calcareous soil, 2-V-1996, G. Aragón & I. Martínez (herb. Martínez 1263).

Pezizella epithallina (W. Phillips & Plowr.) Sacc.
Ref.: Dennis (1972: 472), Hawksworth (1980a: 378).

P. epithallina is known from the British Isles (Dennis 1972: 473; Hawksworth 1980a: 380, 1983a: 25; Vouaux 1914: 178; Watson 1948: 308), Denmark (Hawksworth 1980a: 379), Germany (Ernst 1993: 330; Feuerer & Ernst 1993: 99; Wirth 1994: 19), Luxembourg (Diederich et al. 1991: 35; Goffinet et al. 1994: 200), Norway (Kümmerling & Alstrup 1992: 121; Santesson 1993: 163), Russia (Zhurbenko 1996: 226; Zhurbenko & Santesson 1996: 156) and Sweden (Santesson 1993: 163). New for the Iberian Peninsula.

Studied material: **SPAIN**: **Málaga**: Tolox, Sierra de las Nieves, 30SUF1801, 1200 m, on *Peltigera canina*, on calcareous rocks, 12-IV-1992, G. Aragón & I. Martínez (herb. Martínez 1257).

Phoma epiparmelia Vouaux s. ampl.
Ref.: Vouaux (1914: 282), Hawksworth (1981: 80).

The studied specimens have immersed dark pycnidia 50-80 µm in diam., unbranched sinuous, conidiogenous cells 9-12 x 2-2.5 µm. The conidia are simple, hyaline and reniform and measure 6-8 x 2.5-3 µm. These characters are very similar to the description of *Ph. epiparmelia*, but our measures are somewhat different from those mentioned by Vouaux. This species was sofar only known from the type locality in Croatia (Vouaux 1914: 282). It is a new species for the Iberian Peninsula.

Studied material: **SPAIN**: **Asturias**: Picos de Europa, Amieva, río Dobra, 30TUN3487, 1150 m, on *Peltigera horizontalis*, on calcareous rocks, 15-X-1995, G. Aragón & A. Herrero (herb. Martínez 1300, 1325). **Burgos**: Berberana, puerto de Orduña, Monte de Santiago, 30TWN0054, 850 m, on *P. horizontalis*, on *Fagus sylvatica*, 24-VIII-1994, A. Herrero (herb. Martínez 1302).

Phoma lobariae Diederich & Etayo
Ref.: Etayo & Diederich (1995: 213).

This lichenicolous coelomycete was recently described from the French Pyrenees (Etayo & Diederich 1995: 213), but it is also known from the west side of this mountain chain (Etayo & Diederich 1996a: 110).

Studied material: **SPAIN**: **León**: Suárbol, 29TPH74, 1100 m, on *Lobaria pulmonaria*, on *Quercus petraea*, 7-VII-1990, A. Terrón (LEB 2263); Oseja de Sajambre, puerto del Portón, 30TUN3574, 1300 m, on *L. pulmonaria*, on *Fagus sylvatica*, 4-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1398).

Phoma peltigerae (P. Karst.) D. Hawksw.
Ref.: Hawksworth (1981: 54).

Ph. peltigerae is known from Austria (Berger 1996: 70; Hafellner 1994b: 19; Hafellner & Türk 1995: 622), Finland (Hawksworth 1981: 54, based on type collection), France (Bouly de Lesdain 1910: 276; Rondon 1968-1969: 19; Vouaux 1914: 192 as *Phyllosticta peltigerae*), Germany (Keissler 1930: 536, 1933: 392 as *Phyllosticta peltigerae* but Keissler did not see conidia; Wirth 1994: 19), Luxembourg (Diederich et al. 1991: 36; Goffinet et al. 1994: 200), Norway and Sweden (Santesson 1993: 166). This is a new species for the Iberian Peninsula.

Studied material: **SPAIN**: **Albacete**: Vianos, Sierra del Calar del Mundo, fuente de las Raigadas, 30SWH4552, 1450 m, on *Peltigera praetextata*, on Quercus faginea, 5-I-1996, G. Aragón & I. Martínez (herb. Martínez 1320); Ríopar, Sierra del Calar del Mundo, cueva de los Chorros, 30SWH4956, 1350 m, on *P. ponojensis*, on calcareous rocks, 10-II-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1321). **Guadalajara**: Torremocha del Campo, La Fuensaviñán, 30TWL3533, on *P. rufescens*, on sandy soil, J. Castillo (herb. Martínez 1323). **León**: Villablino, Rioscuro,

30TQH2256, 1450 m, on *P. canina*, on slopes, 24-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1322). **Teruel**: Albarracín, Sierra de Albarracín, barranco del Navazo, 30TXK3473, 1200 m, on *P. rufescens*, on sandstones, 18-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1324).

Phoma sp.

Conidiomata pycnidial, immersed, commonly in groups, blackish, subglobose, 122 - 136 ± 14.5 - 160 x 88 - 120 ± 20 - 141 µm, ostiolate; wall with brown to dark brown cells, cells pseudoparenchymatous, 6.7 - 7.7 ± 1.4 - 8.7 µm long and 7.8 - 8.5 ± 0.9 - 9.2 µm wide, the inner cells are brown. Conidiogenous cells arising from the inner wall of the conidioma, subglobose to broadly obpyriform, hyaline, smooth-walled, phialidic, 5 x 7 µm. Conidia abundant, ellipsoid, rounded at the apices, hyaline, simple, almost always guttulate, smooth-walled, 5.5 - 6.2 ± 0.5 - 7.2 x 2.4 - 2.9 ± 0.2 - 3.2 µm. The infection forms necrotic decolourized patches ± 1-3 x 2-5 mm in diam., surrounded by a blackened zone of tissue.

This taxon seems to be similar to *Ph. cytospora* by its type of infection, but the conidioma, the conidia and the host species are different. Also, it is different from *Phoma lobariae*, recently described by Etayo & Diederich (1995: 213), because *Ph. lobariae* has smaller conidia and the structure of the pycnidium is also different. *Phoma lobariicola*, recently described by Alstrup (1997: 28), shows a different type of infection, has a different host species and the measurements of the conidioma, conidiogenous cells and conidia are different from the Spanish material of *Phoma* sp. As we have only two specimens of this taxon, we prefer to wait until additional material is discovered, before formally describing it.

Studied material: **SPAIN**: **Huelva:** Fuenteheridos, Sierra de Aracena, 750 m, on *Lobaria pulmonaria*, on *Castanea sativa*, 20-VII-1995, A. R. Burgaz (herb. Martínez 1417). **Salamanca**: Sequeros, Sierra de la Peña de Francia, 29TQE5289, 800 m, on *L. pulmonaria*, on *Quercus pyrenaica*, 12-VIII-1994, T. Rojas (herb. Martínez 1416).

Plectocarpon lichenum (Sommerf.) D. Hawksw.
(Syn. *Lichenomyces lichenum* (Sommerf.) R. Sant.).
Ref.: Santesson (1960: 501), Hawksworth & Galloway (1984: 86), Diederich & Etayo (1994: 592).

This species is widely distributed in continental Europe and the British Isles (Diederich & Etayo 1994: 592), Azores (Arvidsson 1990: 24), Corsica (Hafellner 1994a: 227), Faroes (Alstrup et al. 1994: 74), North America (Esslinger & Egan 1995: 521; Noble et al. 1987: 64; Thomson & Ahti 1994: 156), New Zealand (Kondratyuk & Galloway 1994: 27) and South Africa (Doidge 1950: 223). In Spain and in the Canary Islands it is known from many localities (Álvarez & Carballal 1992: 366; Diederich & Etayo 1994: 592; Etayo 1996b: 105; Etayo & Breuss 1996: 110; Gómez-Bolea 1985: 38; Klement 1965: 547; Marcos Laso 1993: 159; Santesson 1960: 502, 1994: 16).

Studied material: **SPAIN**: Canary Islands, **La Gomera**: La Montañeta E ober El Cedro, am Höhenrücken SW vom Gipfel, ca. 1020 m, 28°07'30"N/17°12'W; *Erica*-Buschwald mit Stockausschlag von *Laurus*, auf Zweigen von *Laurus*, on *Lobaria pulmonaria* var. *meridionalis*, 18-II-1991, J. Hafellner 33826 & A. Hafellner (herb. Hafellner). **Asturias**: Parque Nacional de Muniellos, N von Cangas de Narcea, 650 m, on *L. pulmonaria*, Wald in Talschluß mit Silikatblöcken, 4-IX-1980, J. Hafellner 10228 (herb. Hafellner); Abhänge des Cordal de la Mesa N unter dem Puerto de Ventana, 1340 m, on *L. pulmonaria*, Fagetum mit einzelnen Silikatblöcken, 1-IX-1980, J. Hafellner 10501 (herb. Hafellner). **León**: Puerto de Ancares, 29TPH84, 1500 m, on *L. pulmonaria*, on *Ilex aquifolium*, 11-IX-1988, A. Terrón (LEB 917); Valle de Mirva-Burón, 30TUN36, 1300 m, on *L. pulmonaria*, on *Fagus sylvatica*, 7-VII-1987, A. Terrón (LEB 862); Oseja de Sajambre, puerto del Portón, 30TUN3574, 1300 m, on *L. pulmonaria*, on *F. sylvatica*, 4-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1399). **Orense**: Santa Cristina, Parada de Sil, 060295, 230 m, on *L. pulmonaria*, on *Castanea sativa*, A. Noguerol (herb. Martínez 1408). **Palencia**: Redondo-Areños, puerto de Piedrasluengas, 30TUN8166, 1345 m, on *L. pulmonaria*, on *F. sylvatica*, 2-VI-1996, A. Herrero (herb. Martínez 1407). **Santander**: Puerto de San Glorio, 30TUN67, 1300 m, on *L. pulmonaria*, on *Quercus petraea*, 7-IX-1990, A. Terrón (LEB 1886); Comunidad de Campoo de Cabuérniga, río Saja, Canal del Infierno, 30TUN9474, 820 m, on *L. pulmonaria*, on slopes, 4-VIII-1995, E. Ortega & P. Navarro (herb. Martínez 1409); Ibidem, 30TUN9372, 1000 m, on *L. pulmonaria*, on *F. sylvatica*, 29-VI-1996, G. Aragón & I. Martínez (herb. Martínez 1410).

Plectocarpon macaronesiae Diederich, Etayo & Sérusiaux
Ref.: Diederich & Etayo (1994: 592).

This taxon has recently been described by Diederich & Etayo (1994: 592), and it is known from Azores, Madeira, La Gomera, La Palma and Tenerife (Etayo 1996b: 105; Diederich & Etayo 1994: 594).

Studied material: **SPAIN**: Canary Islands, **La Gomera**: Bosque del Cedro, on *Lobaria pulmonaria*, 4-I-1990, A. R. Burgaz (herb. Martínez 1405); La Montañeta E ober El Cedro, am Höhenrücken SW vom Gipfel, ca. 1020 m, 28°07'30"N/17°12'W; *Erica*-Buschwald mit Stockausschlag von *Laurus*, auf Zweigen von *Laurus*, on *Lobaria pulmonaria* var. *meridionalis*, 18-II-1991, J. Hafellner 33824 & A. Hafellner (herb. Hafellner). **El Hierro**: El Fayal auf dem zentralen Bergrücken, kurz W vom Degollado Bailadero de las Brujas, ca. 1280 m, 27°43'55"N/17°59'30"W; Myricetum fayae (geschlossener Wald), auf Kronenästen von *Myrica faya*, on *Lobaria pulmonaria* var. *meridionalis*, 8-II-1995, J. Hafellner 43920 (GZU); Camino de Jinama E ober dem Ort Frontera, ca. 920 m, 27°45'20"N/17°59'W; Lorbeerwaldreste auf steilen, N-exponierten Hängen, auf Zweigen von *Ilex canariensis*, on *Lobaria immixta*, 16-II-1995, J. Hafellner 43917 (GZU). **Tenerife**: Macizo de Anaga, Umgebung des Mirador Pico de Ingles NE ober Las Mercedes, ca. 960 m, 28°31'40"N/16°16'W; Lorbeerwald; an Ästen von *Laurus azorica*, on *Lobaria pulmonaria* var. *meridionalis*, together with *Tremella lobariacearum*, 8-II-1989, J. Hafellner 35135 & A. Hafellner (herb. Hafellner); Macizo de Anaga, Monte de las Mercedes, an der Straße nach El Moquinal ca. 0,5 km NW der

Abzweigung von der Straße zum Pico de Ingles, ca. 900 m, 28°31'40"N/16°17'20"W; *Laurus-Erica*-Bestände im Gratbereich, an *Laurus*, on *Lobaria pulmonaria* var. *meridionalis*, 25-II-1989, J. Hafellner 36527 & A. Hafellner (herb. Hafellner).

Plectocarpon scrobiculatae Diederich & Etayo
Ref.: Diederich & Etayo (1994: 597).

P. scrobiculatae is known from France, Great Britain, Norway and Spain (Diederich & Etayo 1994: 597). In Spain it has previously been recorded from Cantabria (Diederich & Etayo 1994: 598) and the Canary Islands (Etayo 1996b: 105; Hafellner 1995b: 140).

Studied material: **SPAIN**: **Ciudad Real**: Fuencaliente, arroyo del Robledo de las Hoyas, 30SUH85, 900 m, on *Lobaria scrobiculata*, on *Quercus pyrenaica*, 5-II-1997, A. R. Burgaz. I. Martínez & F. J. Sarrión (herb. Martínez 1768). **León**: Suárbol, 29TPH74, 1100 m, on *L. scrobiculata*, on *Q. petraea*, 11-IV-1990, A. Terrón (LEB 2269).

Polycoccum crassum Vezda
Ref.: Hawksworth & Diederich (1988: 300).

P. crassum is known from Austria (Hafellner 1994b: 19), the British Isles (Hawksworth & Diederich 1988: 300), the former Czechoslovakia (Hawksworth & Diederich 1988: 300; Vezda 1970: 227), Luxembourg (Diederich 1989: 196; Diederich et al. 1988: 33; Goffinet et al. 1994: 200; Hawksworth & Diederich 1988: 300) and Sweden (Santesson 1993: 175), and it is reported here from the Iberian Peninsula for the first time.

Studied material: **SPAIN**: **Asturias**: Picos de Europa, Amieva, Dobra river, 30TUN3585, 1200 m, on *Peltigera rufescens*, on calcareous rocks, 13-X-1995, G. Aragón & A. Herrero (herb. Martínez 1272). **Málaga**: Parauta, Sierra de las Nieves, 30SUF1459, 950 m, on *P. praetextata*, on calcareous soil, 18-III-1995, G. Aragón & I. Martínez (herb. Martínez 1273).

Polycoccum peltigerae (Fuckel) Vezda
(Syn. *Didymosphaeria peltigerae* Fuckel).
Ref.: Hawksworth & Diederich (1988: 303).

Although *P. peltigerae* is widely distributed in the British Isles and in continental Europe (Hawksworth & Diederich 1988: 303), it is recorded here for the first time from the Iberian Peninsula. In addition to the specimens cited below it has been collected in Navarra (herb. J. Etayo 11807).

Studied material: **ANDORRA**: Les Escaldes-Engordany, collado de Jovell, 31TCH80, 1600 m, on *Peltigera malacea*, on granitic slopes, 6-XII-1994, A. Herrero (herb. Martínez 1275). **SPAIN**: **Albacete**: Vianos, Sierra del Calar del Mundo, fuente de las Raigadas, 30SWH4552, 1450 m, on *P. rufescens*, on calcareous rocks, 5-I-1996, G. Aragón & I. Martínez (herb. Martínez 1274). **Asturias**: Somiedo, Peral, Fuente de Vega

Ventana, 29TQH2468, 1300 m, on *P. praetextata*, on acid rocks, 25-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1281); Somiedo, Valle de Lago, 29TQH2872, 1380 m, on *P. rufescens*, on calcareous rocks, 31-X-1993, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1282, 1283); Ibidem, 29TQH3370, 1700 m, on *P. praetextata*, on calcareous slopes, 31-X-1993, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1284). **Gerona**: Vallfogona del Ripollés, 31TDG47, 1100 m, on *P. degenii*, on calcareous rocks, 10-XII-1995, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1280). **Huesca**: Pirineos, Biescas, Piedrafita de Jaca, 30TYN1931, 1200 m, on *P. praetextata* , on acid rocks, 10-IX-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1278); Pirineos, Torla, barranco Lapazosa, río Ara, 30TYN3731, 1600 m, on *P. elisabethae*, on soil, 2-X-1995, G. Aragón, J. Castillo & A. Herrero (herb. Martínez 1276); Pirineos, Torla, Parque Nacional de Ordesa, 30TYN4126, 1400 m, on *P. praetextata*, on *Fagus sylvatica*, 30-IX-1995, G. Aragón, J. Castillo & A. Herrero (herb. Martínez 1277). **Lérida**: Pirineos, Vaqueira, río Noguera-Pallaresa, 31TCH33, 2000 m, on *P. elisabethae*, *Pinus uncinata* forest, 7-VII-1994, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1279).

Pronectria fissuriprodiens Etayo
Ref.: Etayo & Diederich (1996a: 110).

This species has recently been described from the French and Spanish Pyrenees (Etayo & Diederich 1996a: 111) and has recently been discovered in Scotland (Coppins pers. comm.). New to Macaronesia.

Studied material: **SPAIN**: Canary Islands, **Tenerife**: Macizo de Anaga, Umgebung des Mirador Pico de Ingles NE ober Las Mercedes, ca. 960 m, 28°31'40"N/16°16'W; Lorbeerwald; an Ästen von *Laurus azorica*, on *Lobaria pulmonaria* var. *meridionalis*, 8-II-1989, J. Hafellner 35134 & A. Hafellner (herb. Hafellner). **Santander**: Comunidad de Campoo de Cabuérniga, río Saja, Canal del Infierno, 30TUN9372, 1000 m, on *Lobaria pulmonaria*, on *Fagus sylvatica*, 29-VI-1996, G. Aragón & I. Martínez (herb. Martínez 1397).

Pronectria ornamentata (D. Hawksw.) Lowen
(Syn. *Nectriella ornamentata* D. Hawksw.).
Ref.: Hawksworth (1982c: 756), Lowen (1990: 462).

P. ornamentata is characterized by having 4-spored asci. Hawksworth (1982c: 759) pointed out that the infected parts of the *Peltigera* thallus seem to be dead and the cortex is discolored. In our material we have observed that the upper cortex even disappears in the infected area. This species is known from Luxembourg (Goffinet et al. 1994: 200), Sweden (Santesson 1993: 179), Iceland (Hawksworth 1982c: 756) and Greenland (Alstrup & Hawksworth 1990: 49). New for the Iberian Peninsula.

Studied material: **ANDORRA**: Les Escaldes-Engordany, collado de Jovell, río Madríu, 31TCH80, 1650 m, on *Peltigera didactyla* var. *extenuata*, *Pinus sylvestris* forest, 6-XII-1994, A. Herrero (herb. Martínez 1265).

Pronectria robergei (Mont. & Desm.) Lowen
(Syn. *Nectriella robergei* (Mont. & Desm.) Weese).
Ref.: Hawksworth (1978: 187), Lowen (1990: 462).

In our specimen the perfect state was found growing together with its anamorph *Illosporium carneum*. The species is widely distributed in the British Isles (Hitch 1995: 40; Hawksworth 1980a: 365, 1983a: 11; Watson 1948: 316), continental Europe (Bouly de Lesdain 1914: 156 as *Nectria lichenicola;* Eriksson 1992: 93; Diederich et al. 1988: 33; Goffinet et al. 1994: 200; Hoffmann et al. 1991: 234; Lettau 1958: 148; Obermayer 1993: 143; Santesson 1949: 142, 1993: 179; Vitikainen 1991: 40; Werner 1933: 15; Wittmann & Türk 1994: 200), Spitsbergen (Hafellner 1982: 40) and Greenland (Alstrup & Olech 1993: 38). It is the first time that it was collected in the Iberian Peninsula.

Studied material: **SPAIN**: **Segovia**: Cedillo de la Torre, Umbría de la Hoz, 40TVL4686, 1100 m, on *Peltigera rufescens*, on calcareous soil, 28-XI-1993, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1266).

Pyrenidium actinellum Nyl. s. ampl.
Ref.: Hawksworth (1983b: 547).

This species in the taxonomic concept of Hawksworth (1983b: 547) is known to grow on a wide range of crustose and macrolichens. It is widely distributed in Africa, Asia, Australia, Europe, Greenland, Jamaica, North America (Triebel et al. 1991: 284) and South America (Wedin 1994: 308). In Spain it was reported from Asturias (Santesson 1960: 511, on *Solorina saccata*) and Gerona (Navarro-Rosinés & Hladún 1990: 81, on old or deteriorate thallus of different lichens) and in the Canary Islands from La Gomera (Etayo 1996b: 107, on *Pseudocyphellaria lacerata*; Hafellner 1996a: 6, on *Leptochidium albociliatum*).

Studied material: **SPAIN**: Canary Islands, **El Hierro**: auf dem zentralen Bergrücken NE der Hoya de Fileba, ca. 1,5 km NE der Abzweigung nach Santuario Virgen de los Reyes, ca. 1330 m, 27°44'30"N/17°59'W; *Pinus*-Forst, auf Stammborke von *Pinus*, on *Pseudocyphellaria crocata*, 7-II-1995, J. Hafellner 43913 (herb. Hafellner), J. H. 43926 (GZU). **Gerona**: Vallfogona del Ripollés, 31TDG47, 1100 m, on *Peltigera praetextata*, on calcareous rocks, 10-XII-1995, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1289). **Palencia**: Curavacas, 30TUN66, 2000 m, on *Solorina crocea*, on quarzitic rocks, 9-IX-1990, A. Terrón (LEB 1623). **Santander**: Comunidad de Campoo de Cabuérniga, río Saja, Canal del Infierno, 30TUN9372, 1000 m, on *Lobaria amplissima*, on *Fagus sylvatica*, 28-VI-1996, G. Aragón & I. Martínez (herb. Martínez 1290). **Vizcaya**: Urcabustaiz, Gújuli, 30TWN0758, on *P. horizontalis*, on stump of *Quercus robur*, 25-XII-1994, J. Castillo (herb. Martínez 1288).

Refractohilum peltigerae (Keissl.) D. Hawksw.
Ref.: Hawksworth (1977b: 208).

This hypomycete is known from Austria (Hafellner & Türk 1995: 624; Hawksworth

1979: 249), Bulgaria (Hawksworth 1979: 249; Keissler 1933: 391), Czechoslovakia (Hawksworth 1977b: 208, 1979: 249, 1980a: 367; Keissler 1933: 391), Finland (Hawksworth 1977b: 208, 1980a: 367; Keissler 1933: 391), Norway (Holien & Tønsberg 1994: 73; Santesson 1993: 189), Poland (Miadlikowska & Alstrup 1995: 9), Sweden (Santesson 1993: 205), Faroes (Alstrup et al. 1994: 103), Madeira (Hafellner 1995a: 432), North America (Alstrup & Hawksworth 1990: 59; Esslinger & Egan 1995: 527; Goward & Ahti 1992: 36; Noble et al. 1987: 68) and Greenland (Alstrup & Hawksworth 1990: 59). New for the Iberian Peninsula and the Canary Islands.

Studied material: **SPAIN**: Canary Islands, **Tenerife**: Macizo de Anaga, Vueltas de Taganana, N über dem Forsthaus an der Straße von Las Mercedes nach El Bailadero, 28° 32' 32" N / 16° 13' 45" W, 820 m, on *Peltigera hymenina*, degradierter Lorbeerwald an steilem N-Hang, 19-XII-1994, J. Hafellner 33755 (herb. Hafellner). **Guadalajara**: Orea, Cerro de la Muela, 30TXK1089, 1600 m, on *P. rufescens*, on calcareous rocks, 19-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1430). **La Rioja**: Sierra Cebollera, ermita de Nuestra Señora Lomos de Orio, 1200 m, on *P. collina*, on *Fagus sylvatica*, 29-VII-1996, N. Marcos & P. Navarro (herb. Martínez 1258); Sierra de San Lorenzo, Monasterio de Valvanera, río Valvanera, 30TWM1275, 750 m, on *P. neckeri*, on slopes, 30-VII-1996, N. Marcos & P. Navarro (herb. Martínez 1259).

Rhagadostoma lichenicola var. **brevisporum** Nav.-Ros. & Hladún
Ref.: Navarro-Rosinés & Hladún (1994: 435).

This taxon was separated from *Rh. lichenicola* s. str. by its smaller spores and by a different host species (Navarro-Rosinés & Hladún 1994: 435). The spores of our specimens measure 31-36-40 x 7-7.5 µm. It was previously recorded from Austria (Hafellner & Türk 1995: 624), Italy (Navarro-Rosinés & Hladún 1994: 435; Rondon 1968-69: 713) and Spain, where it was found in Navarra (Etayo, in press) and in Tarragona (Navarro-Rosinés & Hladún 1994: 437).

Studied material: **SPAIN**: **Cuenca**: Valdemeca, Sierra de Valdemeca, 30TXK0748, 1400 m, on *P. rufescens*, on calcareous slopes, 29-V-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1261). **León**: Picos de Europa, Oseja de Sajambre, 30TUN3481, 1250 m, on *P. rufescens*, on slates, 15-X-1995, G. Aragón & A. Herrero (herb. Martínez 1260).

Scutula miliaris (Wallr.) Trevis.
(Syn. *S. wallrothii* Tul.).
Ref.: Triebel et al. (1997: 333).

The widespread species is known from the British Isles (Hawksworth 1980a: 366, 1983a: 23), continental Europe (Alstrup 1993: 63; Clauzade & Roux 1985: 282; Faltynowicz 1993: 34; Keissler 1933: 393, doubtful record because Keissler saw no spores; Kondratyuk et al. 1996: 280; Lettau 1958: 146, 147; Miadlikowska & Alstrup 1995: 9; Rambold & Triebel 1992: 128; Räsanen 1939: 148; Santesson 1984: 16, 1986: 16, 1993: 205; Triebel et al. 1997: 335; Wirth 1994: 23), Faroes (Alstrup et al. 1994:

106), Iceland (Orange 1990: 43), Africa (Triebel et al. 1997: 336), North America (Goward & Ahti 1994: 35; Goward et al. 1994: 59; Noble et al. 1987: 71; Triebel et al. 1997: 335) including Greenland (Alstrup & Hawksworth 1990: 66), and South America (Triebel et al. 1997: 336). It is recorded here for the fist time for the Iberian Peninsula.

Studied material: **SPAIN**: **Asturias**: Picos de Europa, Amieva, río Dobra, 30TUN3487, 1150 m, on *Peltigera horizontalis*, on calcareous rocks, 15-X-1995, G. Aragón & A. Herrero (herb. Martínez 1299). **Cáceres**: San Martín de Trevejo, Sierra de Gata, río de la Vega, 29TPE8856, 800 m, on *P. horizontalis*, on granitic slopes, 4-IV-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1295, 1394). **Ciudad Real**: Fuencaliente, río Cereceda, 30SUH95, 900 m, on *P. praetextata*, on stump of *Quercus pyrenaica*, 3-I-1991, F. J. Sarrión (herb. Martínez 1392). **Madrid**: El Escorial, La Herrería, 30TVK09, on *P. praetextata*, on *Q. pyrenaica*, 6-V-1996, G. Aragón & I. Martínez (herb. Martínez 1393).

Stigmidium leucophlebiae Cl. Roux & Triebel ad int.
Ref.: Roux & Triebel (1994: 495).

A revision of a number of *Stigmidium* species has recently been published by Roux & Triebel (1994). These authors recognize three *Stigmidium* species growing on *Peltigera*. This so far invalidly described species is distinguished from *S. peltideae* mainly on spore size, the former having larger ascospores. The spore walls of both species give a positive reaction with Cresyl Blue. *S. leucophlebiae* was originally reported only from Sweden, thus, our specimen representing the second record for the taxon. New for the Iberian Peninsula.

Studied material: **SPAIN**: **Gérona**: Pyrenäen, Nuria N von Ribas de Freser, NW-Hänge SE ober der Bergstation der Zahnradbahn, 2100 - 2300 m, lockerer *Pinus uncinata*-Wald, on *Peltigera leucophlebia*, 27-V-1983, J. Hafellner 17605 (GZU).

Stigmidium peltideae (Vain.) R. Sant.
Ref.: Roux & Triebel (1994: 500).

Stigmidium peltideae is characterized by having pseudotetrablastic spores, a metachromatic endoascus and epispore with Cresyl Blue. In the studied material we have observed that ascomata of *St. peltideae* are found in dark areas of the oldest parts of *Peltigera* thalli, but Roux & Triebel (1994) think that this species is probably not responsible for this alteration. The species is known with certainty from Finland, Italy, Scotland (Roux & Triebel 1994: 503), Russia (Zhurbenko 1996: 227; Zhurbenko & Santesson 1996: 159) and Ukraine (Miadlikowska 1996: 132). Santesson (1960: 510) reported *St. peltideae* from Asturias (Spain), but it would be neccesary to revise that material after the monograph of Roux & Triebel (1994).

Studied material: **ANDORRA**: Pirineos, Vall d'Inclés, refugio de Sisqueró, 31TCH9316, 2100 m, on *Peltigera rufescens*, on granitic rocks, 3-VII-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1336). **SPAIN**: **Asturias**: Páramo, río Teverga,

30TQH47, 1400 m, on *P. horizontalis*, on acid rocks, 25-X-1994, A. R. Burgaz & I. Martínez (herb. Martínez 1335).

Stigmidium pseudopeltideae Cl. Roux & Triebel ad int.
Ref.: Roux & Triebel (1994: 503).

This species, invalidly described by Roux & Triebel (1994) growing on a *Peltigera* thallus, is characterized by non-pseudotetrablastic spores, lacking a metachromatic reaction in the endoascus and epispore. The Iberian material has smaller perithecia (60-80 µm) than the measurements given by Roux & Triebel (90-100 µm), but in the other characters it is very similar. Our material is also growing in the decoloured areas of the *Peltigera* thallus as pointed out by Roux & Triebel (1994). This species is known from Austria, Switzerland (Roux & Triebel 1994: 503) and Russia (Zhurbenko 1996: 227, Zhurbenko & Santesson 1996: 159, as *Stigmidium* cf. *pseudopeltideae*). It is recorded here as new for the Iberian Peninsula and it seems to be the most common *Stigmidium* species on *Peltigera* in this area.

Studied material: **PORTUGAL**: **Beira Litoral**: Luso, Bussaco, Cruza Alta, 29TNE56, 500 m, on *Peltigera membranacea*, *Quercus robur* forest, 28-I-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1360). **SPAIN**: **Asturias**: Cangas de Narcea, Pueblo de Rengos, 29TPH9363, 1200 m, on *P. membranacea,* on slates slopes, 14-VIII-1994, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1370); Cangas de Narcea, Genestoso, río Cibea, 29TQH1170, 1200 m, on *P. canina*, on quarzitic rocks, 15-VIII-1994, T. Almaraz, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1371). **Burgos**: Berberana, puerto de Orduña, Monte de Santiago, 30TWN0054, 850 m, on *P. praetextata*, on calcareous rocks, 24-VIII-1994, A. Herrero (herb. Martínez 1363). **Cáceres**: Villar del Pedroso, Garganta del Mesta, 30SUJ0285, 600 m, on *P. praetextata*, on quarzitic rocks, 4-I-1995, G. Aragón & I. Martínez (herb. Martínez 1369). **Jaén**: Sierra Morena, Valdeazores, Despeñaperros, 30SVH55, 660 m, on *P. neckeri*, on quarzitic rocks, 15-XI-1993, A. R. Burgaz (herb. Martínez 1366). **León**: Picos de Europa, Posada de Valdeón, río Vareda, 30TUN3882, 1250 m, on *P. praetextata*, on *Fagus sylvatica*, 13-X-1995, G. Aragón & A. Herrero (herb. Martínez 1362); Ibidem, 30TUN4178, 1025 m, on *P. praetextata*, on slates, 5-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1372). **Lérida**. Pirineos, Artiga de Lin, Vall d'Aran, on *P. praetextata*, on acid rocks, 20-VIII-1993, G. Aragón & I. Martínez, (herb. Martínez 1374). **Madrid**: Canencia, arroyo del Sestil del Mahillo, 30TVL3426, 1300 m, on *P. membranacea*, on acid rocks, 30-I-1994, G. Aragón & I. Martínez (herb. Martínez 1373); Ibidem, on *P. praetextata* (herb. Martínez 1367). **Navarra**: Ochagavía, río Urchuria, 30TXN5459, 1100 m, on *P. membranacea*, on calcareous rocks, 11-IV-1995, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1365); Ochagavía, barranco Ibarrondoa, 30TXN5960, 1100 m, on *P. praetextata*, on calcareous rocks, 12-IV-1995, G. Aragón, J. Castillo & I. Martínez (herb. Martínez 1364). **Segovia**: Riofrío de Riaza, puerto de la Quesera, 30TVL6563, 1605 m, on *P. membranacea*, on acid rocks, 12-VI-1993, E. Munín & T. Rojas (herb. Martínez 1361). **Tarragona**: Sierra de Prades, an der Straße vom Monasterio de Poblet nach Prades kurz ober der Abzweigung nach Vilanova de Prades, ca. 900 m, Quercetum pyrenaicae mit Silikatblöcken, on *Peltigera*

leucophlebia, 23-V-1983, J. Hafellner 17570, rev. I. Martinez (herb. Hafellner). **Teruel**: Orihuela del Tremedal, Sierra de Albarracín, arroyo de Gargantavellanos, 30TXK1188, 1540 m, on *P. canina*, on quarzitic rocks, 19-V-1996, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1368).

Stigmidium solorinarium (Vain.) D. Hawksw.
Ref.: Hawksworth (1986: 508), Roux & Triebel (1994: 509).

This species has pseudotetrablastic spores and the endoascus and epispore give a metachromatic reaction. So far it is known from the British Isles and continental Europe (Diederich 1989: 214 as *S. peltideae* on *Solorina saccata;* Diederich et al. 1991: 42; Hafellner 1996b: 80; Hafellner & Wittmann 1996: 12; Hawksworth 1983a: 14, 1986: 508; Hawksworth & Paterson 1993: 103; Mayrhofer et al. 1989: 243; Roux & Triebel 1994: 509; Santesson 1984: 18; Zhurbenko & Santesson 1996: 159) and Greenland (Alstrup & Hawksworth 1990: 67). However, all these data have to be revised as some might belong to *St. croceae* (Arnold) Roux & Triebel (Diederich, pers. comm.). In Spain it is already known from Barcelona (Navarro-Rosinés et al. 1994: 191; Roux & Triebel 1994: 509) and Navarra (Etayo, in press).

Studied material: **SPAIN**: **Lérida**: La Coma i la Pedra, Tuixén, 31TCG8170, 1750 m, on *Solorina saccata*, on calcareous rocks, 4-VII-1996, A. R. Burgaz & I. Martínez (herb. Martínez 1400).

Thelocarpon epibolum var. **epithallinum** (Leight.) G. Salisbury
Ref.: Salisbury (1966: 180)

The species is known to be widely distributed in Europe (e.g. Salisbury 1966: 180) and is also known from North America (Ahti 1973: 66, Esslinger & Egan 1995: 533), but often the variety is not indicated. It is recorded here as new for the Iberian Peninsula.

Studied material: **SPAIN**: **Tarragona**: Sierra de Prades, an der Straße vom Monasterio de Poblet nach Prades kurz ober der Abzweigung nach Vilanova de Prades, ca. 900 m, Quercetum pyrenaicae mit Silikatblöcken, on *Peltigera leucophlebia*, 23-V-1983, J. Hafellner 17572 (GZU).

Vezdaea aestivalis (Ohlert) Tscherm.-Woess & Poelt
Ref.: Coppins (1987: 171).

V. aestivalis is known from the British Isles and continental Europe, growing on mosses and plants debris on calcareous rocks (Purvis 1992b: 643) and more rarely on trees (Coppins pers. comm.). It was previously reported growing on *Peltigera* from Austria (Giralt et al. 1993: 718), Belgium, Luxembourg (Goffinet et al. 1994: 200) and Poland (Miadlikowska & Alstrup 1995: 10). In Spain it was reported from Mallorca growing on bryophytes (Etayo 1996a: 120) and from Tarragona (Boqueras et al. 1993: 106).

Studied material: **SPAIN**: **Tarragona**: La Sénia, Reserva de los Puertos de Tortosa y

Beceite, fuente del Retaule, 31TBF61, 1100 m, on *Peltigera neckeri*, on calcareous slopes, 17-III-1996, A. Herrero (herb. Martínez 1375).

Wentiomyces peltigericola D. Hawksw.
Ref.: Hawksworth (1980a: 384).

This pyrenomycete is known from Austria (Hafellner & Türk 1995: 632; Hoffmann et al. 1991: 236; Kümmerling & Alstrup 1992: 121), British Isles (Hawksworth 1980a: 385, 1983a: 14), Faroes (Alstrup & Hawksworth 1990: 75; Alstrup et al. 1994: 109), Norway (Hafellner 1993: 763; Holien & Tønsberg 1994: 74; Kümmerling & Alstrup 1992: 121; Øvstedal 1986: 21; Santesson 1993: 237), Russia (Zhurbenko 1996: 227; Zhurbenko & Santesson 1996: 159), Sweden (Eriksson 1992: 112; Santesson 1988: 9, 1993: 237; Thor 1992: 28) and Greenland (Alstrup & Hawksworth 1990: 75), but this is the first time that it is reported from Spain. Kümmerling & Alstrup (1992: 121) underlined that this species usually grows on *Peltigera aphthosa* together with *Thelocarpon epibolum* and *Graphium aphthosae*, but in the Spanish material these species sofar have not been found together on the same *Peltigera* thallus. New for the Iberian Peninsula.

Studied material: **SPAIN**: **Asturias**: Puerto de Leitariegos, Laguna Arbas, 1650 m, on *Peltigera britannica*, on gneiss, 6-IX-1980, J. Hafellner 10173 (herb. Hafellner). **León**: Picos de Europa, Posada de Valdeón, 30TUN4178, 1025 m, on *P. praetextata*, on slates, 5-VII-1995, A. R. Burgaz & I. Martínez (herb. Martínez 1304). **Lérida**: Pirineos, Espot, lago Ratera, 31TCH3616, 2100 m, on *P. aphthosa*, *Pinus uncinata* forest, 6-VII-1994, G. Aragón, J. Castillo, A. Herrero & I. Martínez (herb. Martínez 1303). **Tarragona**: Sierra de Prades, an der Straße vom Monasterio de Poblet nach Prades kurz ober der Abzweigung nach Vilanova de Prades, ca. 900 m, Quercetum pyrenaicae mit Silikatblöcken, on *Peltigera leucophlebia*, 23-V-1983, J. Hafellner 17576 (GZU).

Zwackhiomyces berengerianus (Arnold) Grube & Triebel
(Syn. *Endococcus hygrophilus* var. *berengerianus* Arnold).
Ref.: Grube & Hafellner (1990: 308).

This species has been reported from Austria (Grube & Hafellner 1990: 308; Hafellner & Türk 1995: 632), Italy (Grube & Hafellner 1990: 308; Triebel 1989: 116), Russia (Zhurbenko 1996: 227; Zhurbenko & Santesson 1996: 159, identification uncertain), Scotland (Grube & Hafellner 1990: 308), Sweden (Santesson 1993: 240; Thor 1992: 28) and Alaska (Zhurbenko et al. 1995: 96). In the Spanish material *Z. berengerianus* grows on *Bacidia bagliettoana* which itself is growing on *Peltigera rufescens*. New for the Iberian Peninsula.

Studied material: **SPAIN**: **Albacete**: Villaverde de Guadalimar, pico de la Sarga, 30SWH4162, 1700 m, on *Bacidia bagliettoana*, on *Peltigera rufescens*, 28-VII-1995, G. Aragón, A. Herrero & I. Martínez (herb. Martínez 1423).

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THE LICHEN GENUS PERTUSARIA (LICHENISED ASCOMYCOTINA) IN PAPUA NEW GUINEA: THREE NEW SPECIES AND TWO NEW REPORTS

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ABSTRACT: Three new species in the lichen genus *Pertusaria* are described from Papua New Guinea. The new species are: *Pertusaria bundiensis*, *P. praecipua* and *P. ramuensis*. *Pertusaria dehiscens* Müll. Arg. and *P. orarensis* A.W. Archer & Elix are reported for the first time from the same region. The 3,4-benzocoumarins, alternariol and its methyl ether are reported for the first time from a lichen source.

INTRODUCTION

Recent investigations of the lichen genus *Pertusaria* in Papua New Guinea (Streimann & Sipman 1994, Aptroot *et al.* 1995, Archer *et al.* 1995, Elix *et al.* 1997) have shown the occurrence of a wide variety of taxa in the genus, and the most recent publication (Archer & Elix 1998) contains a key to 66 taxa from the region. An examination of additional specimens collected by H. Sipman in 1995 has revealed the presence of three new species, which are described here. In addition the occurrence of *Pertusaria dehiscens* Müll. Arg. and *P. orarensis* A.W. Archer & Elix is recorded. Alternariol and its methyl ether are reported for the first time from a lichen source, *viz. P. praecipua*. The chemistry of the specimens was determined by thin-layer chromatography (Elix & Ernst-Russell 1993) and liquid chromatography (Feige *et al.* 1993).

NEW *PERTUSARIA* SPECIES

1. Pertusaria bundiensis A.W. Archer & Elix, *sp. nov.* Figure 1

Thallus olivaceus, tenuis, superficies hebeta, subtuberculata, sorediis et isidiis destitutus; corticola. Apothecia verruciformia, conspicua, numerosa, dispersa vel confluentia, thallo concolora, 0.5-0.7 mm diam. Ostiola conspicua, nigra, 0.05-0.1 mm diam., in verrucis singula. Ascosporae 2nae, elongatae-ellipsoideae, parietibus exteriis undulatis ('asper' sensu Dibben 1980: 11), 150-175 µm longae, 37-40 µm latae vel raro in ascis singula, 200 µm longae, 45 µm latae.
Thallus acida 2'-*O*-methylperlatolicum et sticticum et 4,5-dichlorolichexanthone continens.

Type: PAPUA NEW GUINEA. MADANG PROVINCE: S side of Ramu Valley, Bundi village, on slope towards Mt. Pizetara, 5°44.9'S, 145°14.1'E, alt. 1300-1600 m, in disturbed montane forest; *H. Sipman 39240*, 8.xi.1995; holotype B.

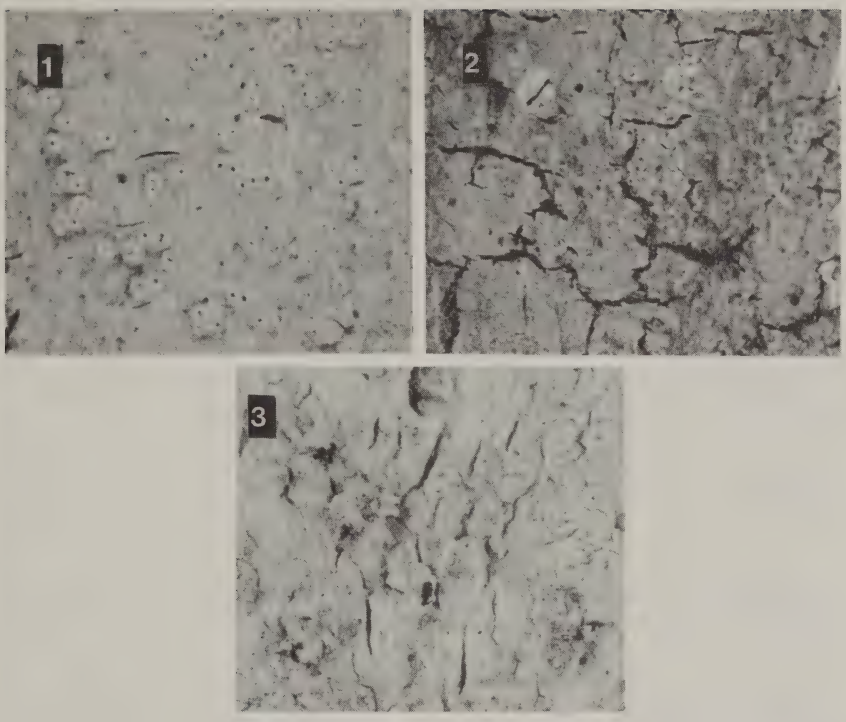
Thallus pale olive-green, thin, corticolous, surface subtuberculate and dull, lacking soredia and isidia. *Apothecia* verruciform, conspicuous, numerous, scattered or sometimes confluent, flattened-hemispherical, concolorous with the thallus, 0.5-0.7 mm diam. *Ostioles* conspicuous, black, 0.05-0.1 mm diam., 1 per verruca. *Ascospores* 2 per ascus, elongate ellipsoid, rough, 150-175 µm long, 37-40 µm wide, or rarely 1 per ascus, 200 µm long, 45 µm wide.

CHEMISTRY. K-, KC-, C-, Pd-; 2'-*O*-methylperlatolic acid (major), stictic acid (minor), constictic acid (trace), peristictic acid (trace) cryptostictic acid (trace) and 4,5-dichlorolichexanthone (trace).

Pertusaria bundiensis is characterised by asci with two rough-walled ascospores and the presence of 2'-*O*-methylperlatolic and stictic acids with traces of 4,5-dichlorolichexanthone, The species is chemically and morphologically similar to *P. microstoma* Müll. Arg. (Archer 1997: 107), which also occurs in Papua New Guinea, but that species has asci with four rough-walled ascospores 100-150(-200) µm long. The new species is known only from the type specimen. The epithet '*bundiensis*' is derived from the type locality, Bundi village.

2. Pertusaria praecipua A.W. Archer & Elix, *sp. nov.* Fig. 2

Thallus albidus vel albido-hinnuleus, tenuis, superficies laevis et hebetata, sorediis et isidiis destituta; corticola. Apothecia verruciformia, inconspicua, dispersa, thallo concolora, 0.7-1.0 mm diam. Ostiola inconspicua, albido-fusa vel fusca, interdum margine translucide, in verrucis singula. Ascosporae 8nae, irregulariter biseriatae, ellipsoideae, laeves, 75-87 µm longae, 25-32 µm latae.



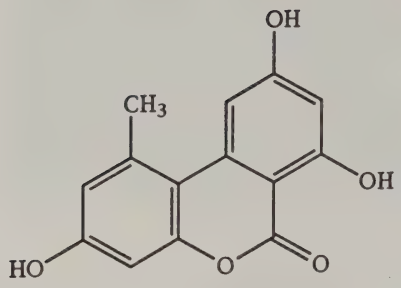
Figures 1-3. New *Pertusaria* species.

1. *P. bundiensis* x4.5. 2. *P. praecipua* x4.5. 3. *P. ramuensis* x4.5.

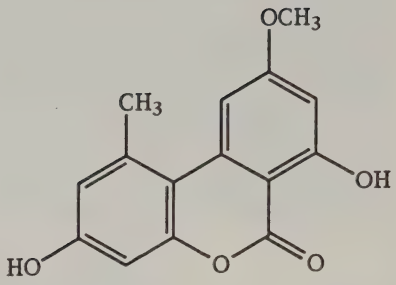
Thallus 4,5-dichlorolichexanthone, alternariol et alternariol methyl ether continens.

Type: PAPUA NEW GUINEA. NORTHERN PROVINCE: Owen Stanley Range, Myola, surroundings of guesthouse, 9°09'S, 147°46'E, alt. 2100 m, on fallen tree in grassland at margin of forest, *H. Sipman 38141*, 14-19.x.1995; holotype: B.

Thallus off-white to pale fawn, thin, corticolous, surface smooth and dull, lacking soredia and isidia. *Apothecia* verruciform, inconspicuous, scattered, flattened-hemispherical, sometimes confluent, concolorous with the thallus, 0.7-1 mm diam. *Ostioles* inconspicuous, pale brown to brown, sometimes with a translucent margin, 1 per verruca. *Ascospores* 8 per ascus, irregularly 2-seriate, ellipsoid, smooth, 75-87 µm long, 25-32 µm wide.



(1)



(2)

CHEMISTRY. K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone (major), alternariol methyl ether (major) and alternariol (minor).

Pertusaria praecipua is chemically unique in producing the 3,4-benzocoumarins alternariol (1) and 9-*O*-methylalternariol (2), as well as 4,5-dichlorolichexanthone, a very common metabolite in *Pertusaria* species. Extraction of decaying wood adjacent to the lichen thallus yielded no trace of (1) or (2), thus confirming that these metabolites had arisen from the *Pertusaria* species and were not contaminants from a co-occuring wood rotting *Alternaria* species. This represents the first reported occurrence of 3,4-benzocoumarins in lichens. Interestingly, the biosynthesis of alternariol and norlichexanthone derivatives arise via the alternative cyclisation and aromatisation of a common C14-polyketide precursor (Thomas 1959, Mosbach 1973).

The identity of (1) and (2) was confirmed by comparison with authentic materials and they exhibited the following chromatographic properties (for methods see Elix, Wardlaw *et al.* 1997).

Alternariol (1) had standard TLC R_F (A) 0.32; R_F (B) 0.30; R_F (C) 0.10. Standard HPLC: R_T 19.15 min.; R_I 0.11.

9-*O*-Methylaternariol (2) had standard TLC R_F (A) 0.45; R_F (B) 0.37; R_F (C) 0.32. Standard HPLC: R_T 29.35 min.; R_I 0.17.

Pertusaria praecipua is characterised by asci with eight biseriate ascospores and the presence of 4,5-dichlorolichexanthone, alternariol and its methyl ether. The epithet *praecipua* is derived from the Latin *praecipuus*, (peculiar, special), a reference to the presence of the benzocoumarin derivatives.

3. Pertusaria ramuensis A.W. Archer & Elix, *sp. nov.* Fig. 3

Thallus olivaceus, tenuis, rimosus et subnitidus, sorediis et isidiis destituta; corticola. Apothecia verruciformia, inconspicua, dispersa vel confluentia, thallo concolora, 0.6-1.0 mm diam. Ostiola inconspicua, punctiformia, albido-fusca vel fusca, in verrucis singula. Ascosporae 2nae, ellipsoideae, laeves, 87-110(-125) µm longae, 35-45 µm latae.
Thallus acidum sticticum continens.

Type: PAPUA NEW GUINEA. MADANG PROVINCE: S side of Ramu Valley, 8-10 km W of Brahman Mission, 5°44.9'S, 145°19.7'E, alt. 100 m, logging site in lowland forest remnant, *H. Sipman 38786*, 29.x.1995; holotype: B.

Thallus pale olive-green, thin, cracked, corticolous, surface subtuberculate and somewhat shiny, lacking soredia and isidia. *Apothecia* verruciform, inconspicuous, scattered, sometimes confluent, concolorous with the thallus, flattened-hemispherical, 0.6-1.0 mm diam., confluent apothecia irregular in outline, 1.5-2 mm wide. *Ostioles* inconspicuous, punctiform, pale brown to brown, 1 per verruca. *Ascospores* 2 per ascus, ellipsoid, smooth, 87-110(-125) µm long, 35-45 µm wide.

CHEMISTRY. K-, KC-, C-, Pd-; stictic acid (major), constictic acid (minor), substictic acid (trace), peristictic acid (trace), cryptostictic acid (trace) and methyl stictic acid (trace).

Pertusaria ramuensis is characterised by asci with two ascospores and the presence of stictic acid and its derivatives and is known only from the type specimen. The epithet *ramuensis* refers to the type locality, Ramu Valley.

NEW REPORTS

Pertusaria dehiscens Müll. Arg.
in *Flora* **67**: 349 (1884).

Type: BRAZIL. Apiahy, *J.I. Puiggari 499 p.p.*, vii.1882; lectotype: G; *fide* Oshio in sched.; residual syntype: *J.I. Puiggari 2197 p.p.*: G.

=*Pertusaria dehiscens* var. *alba* Müll. Arg.
in *Flora* **67**: 349 (1884).
Type: BRAZIL. Apiahy, *J.I. Puiggari 2197 p.p.*; syntype: G.

= *Pertusaria dehiscens* var. *depressior* Müll. Arg.
in *Flora* **67**: 349 (1884).
Type: BRAZIL. Apiahy , *J.I. Puiggari 499 p.p.*. syntype: G.
INDIA. Neilgherries [Nilgiri Hills, *ca.* 250 km SSW of Bangalore], *Ziegler s.n.*; syntype: G.

= *Pertusaria sulphurescens* Müll. Arg.
in *Flora* **67**: 349 (1884).
Type: BRAZIL. Apiahy, *J.I. Puiggari 2197 p.p.*; holotype: G.

Thallus pale to dark olive-green, corticolous, surface dull, wrinkled and cracked, lacking isidia and soredia. *Apothecia* verruciform, conspicuous, numerous, concolorous with the thallus, flattened-hemispherical, 0.8-1.4 mm diam. *Ostioles* black, punctiform, 2-4 per verruca, in a hyaline zone, the zone becoming conspicuous and concave, to 0.8 mm diam. *Ascospores* 8 per ascus, biseriate, smooth, fusiform, 100-115 µm long, 35-47 µm wide.

CHEMISTRY. K-, KC-, C-, Pd-; lichexanthone (major), stictic acid (minor), constictic acid (trace) and cryptostictic acid (trace).

Specimen examined:
PAPUA NEW GUINEA. EASTERN HIGHLANDS PROVINCE: Mt Gahavisuka Provincial Park, 11 km N of Goroka, 6°01'S, 145°25'E, alt. *ca.* 2300 m, in little disturbed mossy mountain forest, on fallen *Castanopsis* tree, *H. Sipman 39175*, 5.xi.1995 (B).

REMARKS. *Pertusaria dehiscens* is characterised by asci with eight biseriate ascospores and the presence of lichexanthone and stictic acid. The species is widely distributed and occurs in Brazil, India and in eastern Australia.

Pertusaria orarensis A.W. Archer & Elix
in A.W. Archer, *Bibl. Lichenol.* **69**: 117.

Type: AUSTRALIA. NEW SOUTH WALES: Orara State Forest, 23 km WNW of Coffs Harbour, 30°15'S, 152°55'E, alt. 600 m, on *Acacia* in clearing by side of road, *A.W. Archer P 857*, 17.xi.1996; holotype: NSW.

DESCRIPTION. *Thallus* pale greenish-grey, thin, corticolous, surface smooth and slightly shiny, lacking soredia and isidia. *Apothecia* verruciform, inconspicuous, scattered, rarely confluent, flattened-hemispherical, concolorous with the thallus, 1-1.5 mm diam. *Ostioles* inconspicuous, black, 1 per verruca. *Ascospores* 8 per ascus, ellipsoid to subfusiform, irregularly 2-seriate, 65-80 µm long, 24-30 µm wide.

CHEMISTRY. K-, KC-, C-, Pd-; 2-chlorolichexanthone (minor-trace), divaricatic acid (major), methyl 2,2'-di-*O*-methyldivaricatate and methyl 2-*O*-methyl-divaricatate (trace).

Specimen examined:
PAPUA NEW GUINEA. MADANG PROVINCE: S side of Ramu Valley, Bundi village, 5°44.9'S, 145°14.1'E, alt. 1300-1600 m, on *Casuarina* branches, *H. Sipman 39289*, 9.xi.1995 (B).

Pertusaria orarensis is characterised by asci with eight ascospores and the presence of 2-chlorolichexanthone and divaricatic acid. The species is chemically similar to *Pertusaria papuana* A.W. Archer & Elix (Archer & Elix 1998) but that species has smaller ascospores, pale ostioles and lacks 2-chlorolichexanthone. *Pertusaria oraraensis* was thought to be endemic to Australia (Archer 1997: 117) but now appears to have a wider distribution.

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The authors are grateful to Dr. H.J.M. Sipman (B) for the loan of specimens, to Dr. P.M. McCarthy (ABRS, Canberra) for correcting the Latin text and to Mrs. J. Wardlaw for technical assistance with liquid chromatography; one of us (AWA) is grateful to the National Herbarium of New South Wales (NSW) for arranging the loan of specimens and for permission to use the facilities of the Herbarium, and JAE gratefully acknowledges the Australian Research Council for generous financial support. We thank Associate Professor K. D. Barrow of the Department of Biochemistry, University of New South Wales, for authentic samples of alternariol and 9-*O*-methylalternariol.

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YUNNANIA GEN. NOV. OF HYPHOMYCETES*

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Abstract

A new genus, *Yunnania*, is here proposed to accommodate a strain isolated from Yunnan Province, China. The diagnostic characteristics of the genus and the type species *Yunnania penicillata* are described.

Introduction

During the course of search of the *Dematiaceae*, an unusual member of the family was isolated from a moulded pork sample from Yunnan, China. The conidial structures borne on Czapek's solution agar (Thom & Fennell, 1949) and Czapek yeast autolysate agar (CYA; Pitt, 1979) bear a striking likeness to the penicilli of *Penicillium* Link, but the colony is greyish black or brownish black, and conidial bases are truncate. The conidial structures and colonies on wort agar resemble those of *Scopulariopsis* Bainier, but the conidia are not annellospores. The fungus can not be assigned to *Paecilomyces* Bainier because the collula of phialides are very short. In the lack of any suitable genus to accommodate the present fungus, therefore, a new genus *Yunnania* is erected.

Descriptions are based on the following media and growth conditions: CYA at 5℃, 25℃, and 37℃; 25% glycerol nitrate agar (G25N) at 25℃ (Pitt,

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1979), and wort agar (wort, 15 balling degree, 2% agar) at 25℃.

Yunnania H. Z. Kong, gen. nov. Pl.I*

Classis Hyphomycetes, Ordo Moniliales, Familia Dematiaceae. Haec genus affinis *Penicillio* Link a quo differt coloniis fusco – griseis vel fuscis, basibus conidicis truncatis; affinis *Scopulariopsi* Bainier a qua differt annellosporis nullis; affinis *Peacilomyceti* Bainier a quo differt collulis brevibus.

Species typica: *Yunnania penicillata* H. Z. Kong.

Colony fuscous – grey or fuscous; penicilli biverticillate or monoverticillate, occasionally terverticillate; phialides ampulliform, with short collula (neck), no annellation; conidia ellipsoidal, truncate at the base.

Yunnania gen. nov. can be easily distinguished from *Penicillium* Link by its grey – black or brown – black colony and conidia truncate at the bases. This genus also differs from *Scopulariopsis* Bainier by the absence of annellospores, and from *Paecilomyces* Bainier by its short collula.

No teleomorph was found.

Etymology: Derived from a Chinese province name.

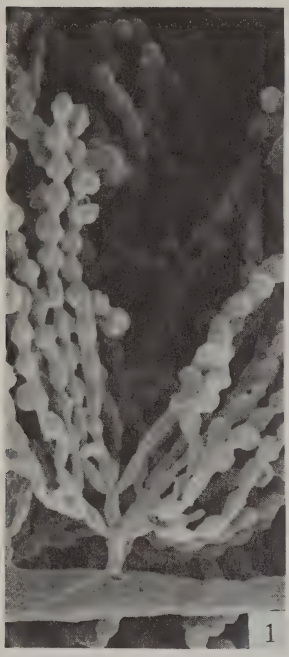
Yunnania penicillata H. Z. Kong sp. nov. Pl.II*

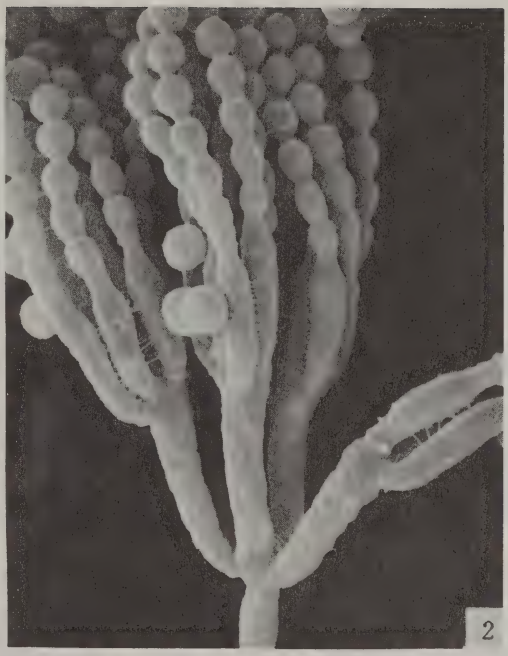
Coloniae in agaro CYA post 7 dies ad 25℃ 25 – 26 mm in diametro, velutinae ac leviter floccosae; structurae conidii abundae in areis centralibus, sparsae in areis marginalibus, fuscae; conidiophora fecunda ex substratis, hyphis funicularibus vel hyphis aeriis, stipites (8.0 –)15 – 50(– 80) × 2.5 –

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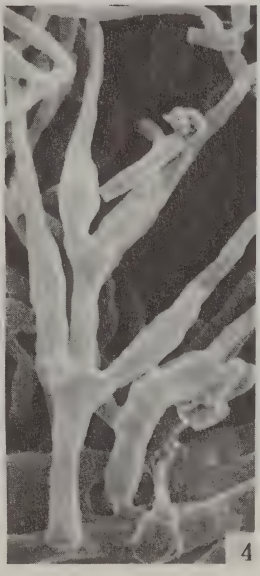
* Pl. I. Penicilli of *Yunnania* and its related genera (SEM): 1. *Yunnania penicillata*, × 1000; 2. *Penicillium chrysogenum*, × 3000; 3. *Scopulariopsis brevicaulis*, × 2000; 4. *Paecilomyces variotii*, × 2000.

Pl. II. *Yunnania penicillata*: 1. Colonies on CYA in 7 days at 25℃; 2. Conidiophore borne from funicular hypha (SEM), × 1500; 3. Conidiophore borne from surface hypga (SEM), × 3000; 4. Conidia truncate at the bases (SEM), × 1200.

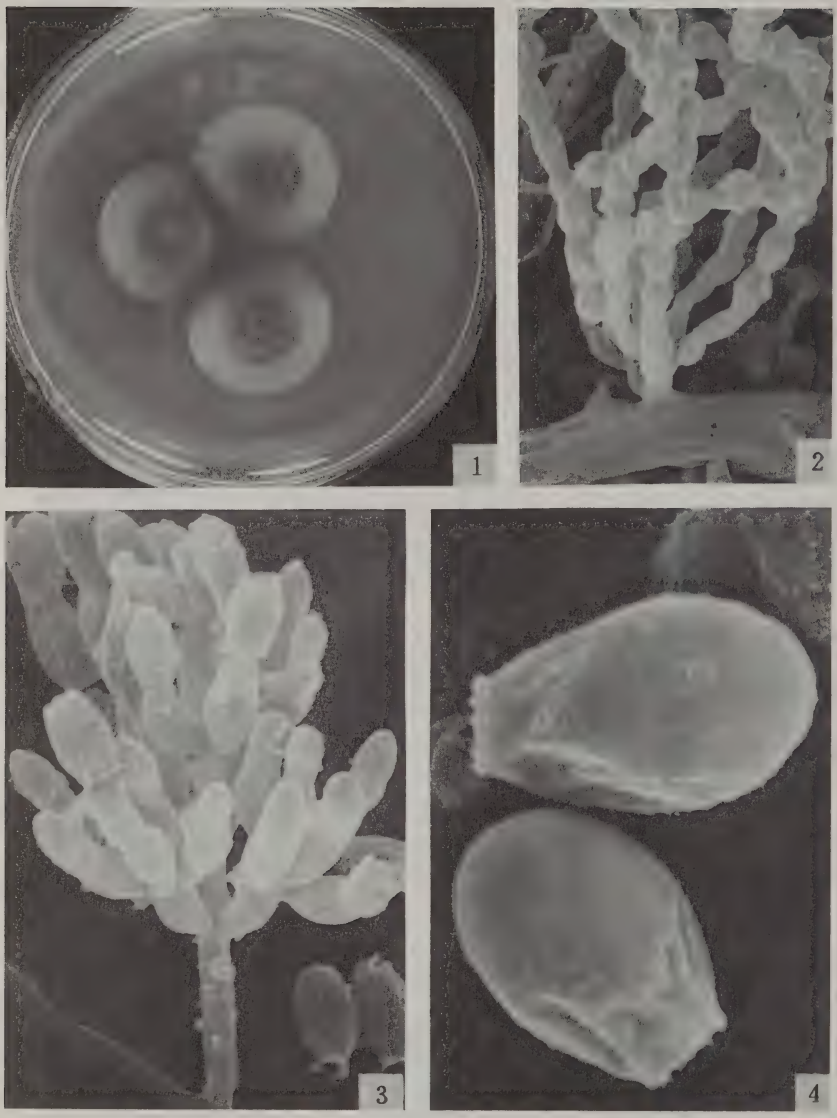








Pl. I



Pl. II

3.2 μm, breves, glabro – tunicati, leviter grisei vel leviter bunnei; metulae(2 –)3 – 4(– 5) in verticillo, 5.0 – 9.0 × 2.0 – 3.0 μm; (3 –)4 – 6 phialides in verticillo, 5.5 – 8.0 × 2.0 – 2.5 μm, ampulliformes, brevicolles; conidia ellipsoidea, glabro – tunicata, 4.5 – 6.5 × 2.5 – 3.2(– 3.5) μm, ad basim truncata.

Holotypus HMAS 62700 (cultura viva AS 3.4675) isolatus ex carne suilla mucida, Provincia Yunnan Sinica, in Instituto Microbiologico Academiae Sinicae, Beijing, conservatur.

Colonies on CYA at 25℃, 25 – 26 mm diameter in 7 days, plane, velvety and slightly floccose; conidial production varying from abundant in central areas to very sparse in marginal areas, brownish black; exudate and soluble pigment absent; reverse brownish black in central areas, lightly grey in marginal areas.

Colonies on wort agar growing luxuriantly, attaining a diameter of 26 – 28 mm in 7 days at 25℃, showing radial furrows or no, funiculose and lightly floccose, nearly dark grey, but grey white in immature conidial structures; no exudate and soluble pigment produced; reverse black or brown.

G25N, 25℃, 7 days – colonies 3 mm diameter, principally floccose; no conidial structures matured, grey white.

5℃, CYA, 7 days: No germination.

37℃, CYA, 7 days: No germination.

Conidiophores borne from substratum, funicular or aerial hyphae, with short stipes (8.0 –)15 – 50(– 80) × 2.5 – 3.2 μm, smooth – walled, lightly grey or lightly brown; penicilli biverticillate or monoverticillate, occasionally terverticillate; metulae of (2 –)3 – 4(– 5) in verticils, 5.0 – 9.0 × 2.0 – 3.0 μm; phialides in verticils of (3 –)4 – 6, 5.5 – 8.0 × 2.0 – 2.5 μm; conidia ellipsoidal, smooth – walled, lightly brown, truncate at the base, 4.0 – 6.5 × 2.5 – 3.2(– 3.5) μm, conidial chains in irregular to well colomns.

The specific epithet refers to the character of the penicilli.

Acknowledgements

The author would like to express his appreciation to Dr. Jian – yun Zhuang, Prof. Tian – yun Zhang, and Prof. Zhong – yi Zhang for critical review on the manuscript.

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丝孢菌纲的一个新属

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摘要:作者从云南省发霉的猪肉中分离到一株菌。在查氏琼脂上和酵母膏查氏琼脂上培养,菌落中部的分生孢子结构较多,其他部分很稀少或无,呈灰黑或褐黑色;帚状枝类似青霉(*Penicillium* Link),双轮生或单轮生,偶有三轮生,而菌落颜色和分生孢子基部平截等特征而明显不同于青霉。在麦芽汁琼脂上培养,其菌落、帚状枝和分生孢子均类似帚霉(*Scopulariopsis* Bainier),但产孢细胞 - 瓶梗无环痕。该菌和拟青霉 *Paecilomyces* Bainier)也相近,因瓶梗的梗颈很短而不同。

总之,经过一系列的详细研究,该菌无适合的归属,所以建立了一新属,即云南霉属(*Yunnania* H. Z. Kong)。

模式种为帚状云南霉(*Yunnania penicillata*)。

未发现有性型。

该属隶属于暗梗孢科(*Dematiaceae*)。

关键词:暗梗孢科,云南霉属,帚状云南霉。

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POLYCOCCUM CLAUZADEI SP. NOV. (ASCOMYCETES, DOTHIDEALES), CHAMPIGNON LICHÉNICOLE NON LICHÉNISÉ SUR XANTHORIA ELEGANS

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Resumé

Description de *Polycoccum clauzadei* Nav.-Ros. et C. Roux sp. nov. (Dothideales), champignon lichénicole non lichénisé connu seulement dans le département de Vaucluse, France. Il parasite *Xanthoria elegans* (Link) Th. Fr., sur lequel il induit la formation de cécidies. Il est proche de *P. pulvinatum* (Eitner) R. Sant. (= *P. galligenum* Vězda), mais en diffère par des cécidies [(0,2)0,4–0,8 mm de diamètre] et des ascomes périthécioïdes [(120)140–190 × (110)120–180 µm] de taille plus petite, ainsi que par des ascospores typiquement obovoïdes. En outre, les asques de *P. clauzadei* sont un peu plus petits [(45)50–75(80) × 13–15 µm] et la plupart contiennent seulement 4 ou 6 spores.

Resumen

Descripción de *Polycoccum clauzadei* Nav.-Ros. et C. Roux sp. nov. (Dothideales), un hongo liquenícola no liquenizado conocido sólo del departamento de Vaucluse, Francia, en donde se desarrolla sobre *Xanthoria elegans* (Link) Th. Fr. *P. clauzadei* se caracteriza por su comportamiento cecidógeno, y es próximo a *P. pulvinatum* (Eitner) R. Sant. (= *P. galligenum* Vězda), del que se diferencia claramente por el menor tamaño de cecidios [(0,2)0,4–0,8 mm de diámetro] y de ascomas [(120)140–190 × (110)120–180 µm], y por la forma marcadamente (ob)ovoide de las ascósporas. En *P. clauzadei* los ascos [(45)50–75(80) × 13–15 µm] son tambien algo menores y provistos, en general, de sólo 4 o 6 esporas.

Abstract

Description of *Polycoccum clauzadei* Nav.-Ros. et C. Roux sp. nov. (Dothideales), a lichenicolous fungus known only from France (department Vaucluse). It develops on *Xanthoria elegans* (Link) Th. Fr., on the thallus of which it induces the formation of galls. The new species is close to *P. pulvinatum* (Eitner) R. Sant. (= *P. galligenum* Vězda), but differs by smaller galls [(0,2)0,4–0,8 mm diam.] and perithecioid ascomata [(120)140–190 × (110)120–180 µm], and by typically obovoid ascospores. In addition, the asci of *P. clauzadei* are slightly smaller [(45)50–75(80) × 13–15 µm] and are normally 4-6-spored.

Resumo

Priskribo de *Polycoccum clauzadei* Nav.-Ros. et C. Roux sp. nov. (Dothideales), likenloĝa fungo nelikeniĝinta, konata nur en la departemento Vaŭkluzo, Francio. Ĝi kreskas en *Xanthoria elegans* (Link) Th. Fr., ĉe kiu ĝi estigas gajlojn. Ĝi parencas al *P. pulvinatum* (Eitner) R. Sant. (= *P. galligenum* Vězda), sed diferencas de tiu lasta pro gajloj [(0,2)0,4–0,8 mm diametraj] kaj askujoj [(120) 140 – 190 × (110)120–180 µm] ambaŭ pli malgrandaj, kaj pro tipe obovoidaj askosporoj. Krome, la askoj de *P. clauzadei* [(45)50–75(80) × 13–15 µm] estas iom pli malgrandaj kaj plejmulte enhavas nur 4 aŭ 6 sporojn.

Introduction

Au cours de l'étude des spécimens de l'herbier de G. Clauzade (MARSSJ), nous avons découvert sur un échantillon de *Xanthoria elegans* (Link) Th. Fr., un champignon lichénicole non lichénisé bien visible par les cécidies hémisphériques du thalle de l'hôte, contenant de nombreux ascomes périthécioïdes entièrement enfoncés.

Ce champignon appartient a un taxon du genre *Polycoccum* Sauter ex Körber (Dothideales), qui ne figure pas dans la littérature spécialiséé, en particulier ni dans la révision du genre par Hawksworth et Diederich (1988), ni dans les travaux de référence de Clauzade et Roux (1976), Clauzade et al. (1989), Hawksworth (1983), Keissler (1930), Triebel (1989) et Vouaux (1912-1914). Nous avons également pris en considération les publications sur le genre *Polycoccum* postérieures à celle de Hawksworth et Diederich (1988), dans lesquelles plusieurs espèces ont été ajoutées ou exclues du genre (Aptroot et al. 1997, Calatayud et Rico 1995, Diederich 1990, Etayo 1996, Etayo et Diederich 1998, Hawksworth 1985 et 1994, Hawksworth et Miadlikowska 1997, Matzer 1996, Navarro-Rosinés *et al.* 1994).

Nous considérons que ce *Polycoccum*, parasite de *Xanthoria elegans*, constitue une espèce nouvelle, que nous décrivons sous le nom de *Polycoccum clauzadei* Nav.-Ros. et C. Roux sp. nov., en l'honneur de notre ami Georges Clauzade, éminent lichénologue, qui a récolté le matériel type.

Matériel et méthodes

Les coupes microscopiques ont été réalisées à main levée et observées dans l'eau, le lugol (I), une solution aqueuse d'hydroxyde de potassium à 10% (K) et le bleu au lactophénol (bleu coton dans le lactophénol), avec un microscope photonique (grandissement maximal de ×1500). Les dessins ont tous été réalisés avec l'aide d'un tube à dessin, sauf la fig. 1.

Dans l'expression des dimensions des spores, la moyenne est indiquée en italique, encadrée par les valeurs extrêmes après élimination des 10% des valeurs les plus élevées et des 10% des valeurs les plus faibles, tandis que les valeurs extrêmes absolues sont placées entre parenthèses.

Polycoccum clauzadei Nav.-Ros. et C. Roux sp. nov.

Diagnose

Fungus lichenicola in lichenis thallo (*Xanthoria elegans*) parasymbiotice vigens, gallas verrucosas ad basim saepe constrictas, (0,2)0,4–0,8 mm crassas evocans. Ascomata perithecioidea, conferta et immersa in gallis supra lichenis thallum sitas, subglobosa, apicem versus conica, (120)140–190 × (110)120–180 µm, nigra, primum clausa, dein vertice ostiolo simplici punctiformi pertusa, apice suo lichenis thalli superficiem aequantia. Paries (excipulum) atrobrunneus, 15–25 µm crassus ad basim, cellulis pseudoparenchymatis instructa. Stratum ascigenum (centrum) hyalinum, iodo non reagens. Paraphysoides dense ramosae anastomosantesque, septatae, 1,5–2 µm crassae. Asci elongato-clavati, (45)50–75(80) × 13–15 µm, ad basim breviter stipitati, bitunicati, membranis in apice valde incrassatis, 4–6-spori. Ascosporae (ob)ovoideae vel soleiformes, 15–18,5(19,5) × (6,5)7–9(9,5) µm, atrobrunneae, transversim uniseptatae, ad septum nonnumquam constrictae, halonatae, externis membranis rugoso-verruculosis.

Type: France, Vaucluse, Buoux, La Bastide-Neuve, sur tuiles exposées au N, alt. 500 m. 1950/06/09. Leg. G. Clauzade, MARSSJ n° 80 (holotype).
Hôte-type: *Xanthoria elegans* (Link) Th. Fr.

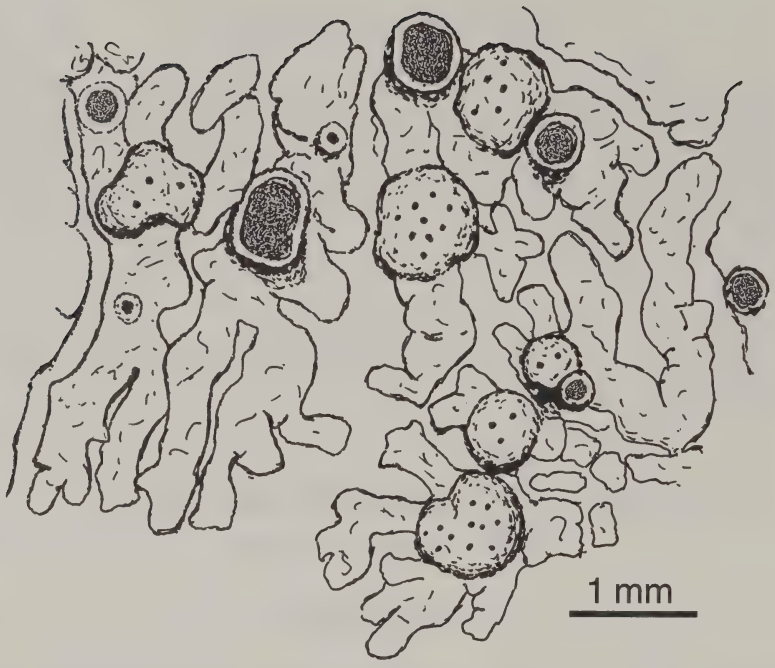


Fig. 1.— *Polycoccum clauzadei*. Aspect macroscopique des cécidies dispersées sur les lobes du thalle de l'hôte (*Xanthoria elegans*).

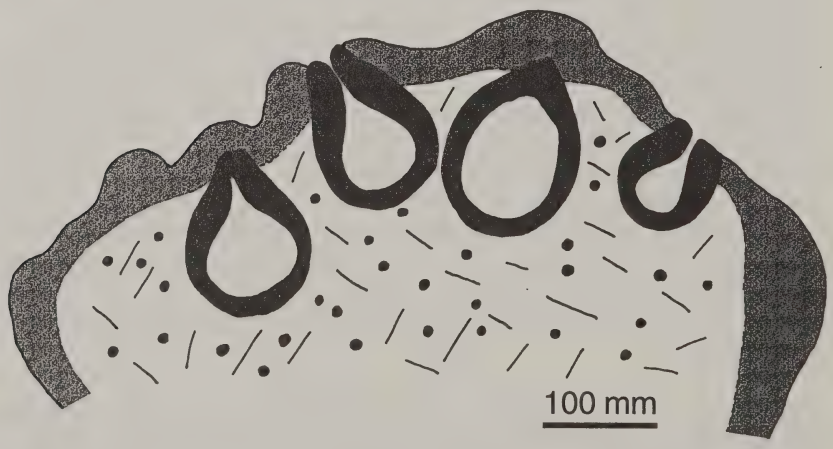
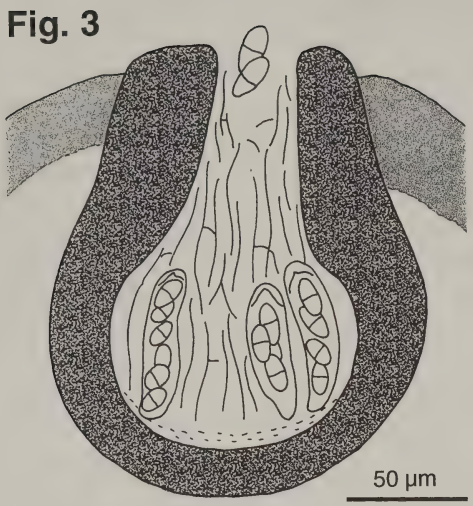
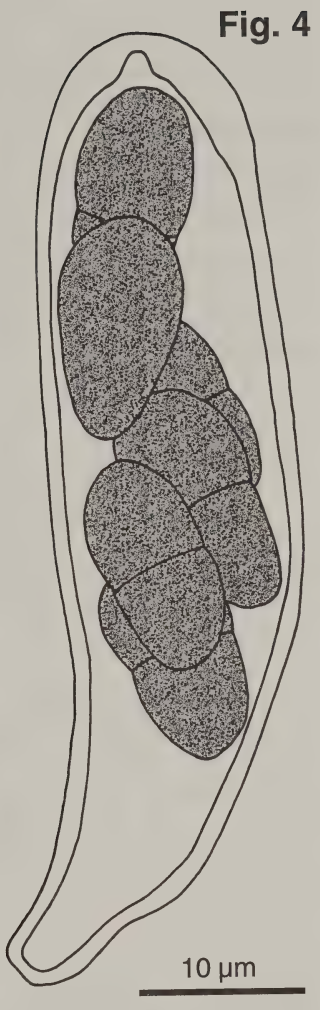


Fig. 2.— *Polycoccum clauzadei*. Structure microscopique d'une cécidie montrant des ascomes, d'après une coupe radiale observée dans l'eau.





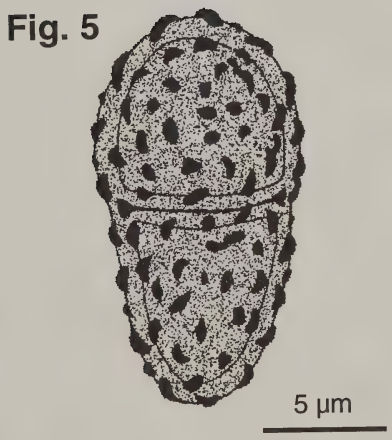


Fig. 3–5.— *Polycoccum clauzadei*. **Fig. 3**. Structure microscopique d'un ascome d'après une coupe verticale passant par l'ostiole (observée dans l'eau). **Fig. 4**. Asque contenant six spores (observé dans l'eau). **Fig. 5**. Détail de la structure d'une ascospore mûre (observée dans l'eau), montrant l'ornementation et la pigmentation de la paroi.

Description

Champignon lichénicole non lichénisé qui induit sur le thalle de l'hôte (*Xanthoria elegans*) la formation de cécidies en forme de verrues hémisphériques ou subglobuleuses, de (0,2)0,4–0,8 mm de diamètre, dispersées sur les lobes du thalle (fig. 1). La surface des cécidies est concolore au reste du thalle du lichen et présente un aspect un peu granuleux à cause d'un cortex abondamment et irrégulièrement fissuré.

Ascomes périthécioïdes (pseudothèces) (fig. 2 et 3) de (120)140–190 × (110)120–180 µm, subglobeux ou largement ovoïdes, groupés et complètement enfoncés dans les cécidies, visibles seulement par la zone ostiolaire noirâtre, exceptionellement légèrement saillants.

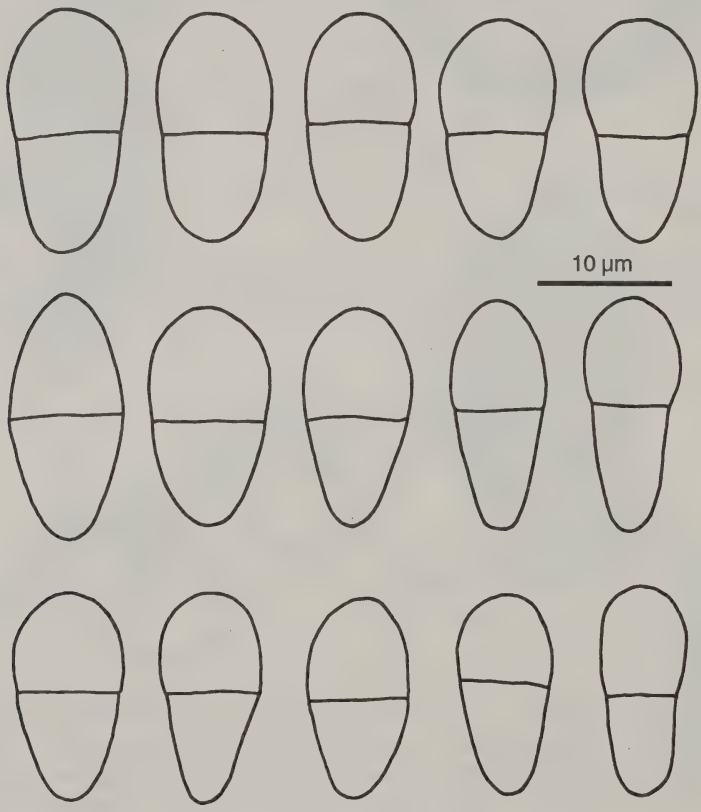


Fig. 6.— *Polycoccum clauzadei*. Variabilité de la forme des ascospores (observées dans l'eau ; pigmentation et ornamentation non representées).

Paroi de l'ascome (excipulum) d'un brun sombre dans toutes ses parties, de 15–25 µm d'épaisseur dans la partie moyenne et basale, un peu plus épaisse au voisinage de l'ostiole, pseudoparenchymateuse (= paraplectenchymateuse), formée par 7–9 couches de cellules allongées tangentiellement.

Hamathécium (fig. 3) constitué par un réseau d'abondantes paraphysoïdes s.s. (au sens de l'école française de CHADEFAUD), distinctement cloisonnées, abondamment ramifiées-anastomosées, de 1,5–2 µm de diamètre.

Asques (fig. 4) claviformes plus ou moins allongés, de (45)50–70(80) × 13–15 µm, à court pédoncule, bituniqués, à paroi s'épaississant en un tholus bien visible, pourvus d'une chambre oculaire, à maturité contenant 4 ou 6 spores ; on observe plus rarement quelques asques octosporés, dans lesquels les spores sont immatures et restent peu pigmentées (spores avortées?).

Ascospores (fig. 5 et 6) de couleur brun sombre, uniseptées, de 15–*16,4*–18,5(19,5) × (6,5)7–*7,9*–9(9,5) µm (25 spores mesurées), à peu près deux fois plus longues que larges [rapport longueur sur largeur de (1,7)1,9–*2,1*–2,3(2,4)], d'obovoïdes à soléiformes, plus rarement ellipsoïdales, distinctement hétéropolaires mais à cloison médiane, non ou à peine rétrécies à celle-ci. Les plus jeunes spores ont une périspore gélatineuse, qui, à maturité, devient densément rugueuse-verruqueuse.

Conidiomes non observés.

Hyphes végétatives incolores ou à peine pigmentées à proximité des ascomes, peu ou pas distinctes des hyphes de l'hôte, de 2–3 µm de diamètre.

Réactions avec le lugol (I) : Toutes les parties sont I–, à l'exception de la gélatine hyméniale et de l'épiplasme qui sont dextrinoïdes et nettement I+ (rouge orangé).

Affinités

Quelques espèces de *Polycoccum* sont déjà connues comme parasites de diverses *Teloschistales* : *P. slaptoniense* D. Hawksw. (HAWKSWORTH 1994: 342), sur *Xanthoria parietina*; *P. infestans* (Speg.) Etayo (ETAYO 1996: 105), sur *Teloschistes chrysophthalmus* et *T. flavicans*; *P. bryonthae* (Arnold) Vězda (HAWKSWORTH et DIEDERICH 1988: 297), décrit comme parasite de *Pertusaria bryontha*, a été mentionné également sur *Caloplaca stillicidiorum*, *C.* sp. (ALSTRUP et HAWKSWORTH 1990 : 54) et sur d'autres lichens ; *P. rugulosarium* (Lynds.)

D. Hawksw. (Hawksworth et Diederich 1988: 304), sur *Caloplaca cirrochrooides, C. regalis* et *C. sublobulata.* Tous ces *Polycoccum* se distinguent nettement de *Polycoccum clauzadei* surtout par leurs spores plus petites, d'une longueur inférieure à 15 µm. En outre chez les trois premières de ces espèces, les asques sont typiquement cylindriques et à spores plus ou moins unisériées.

« *Endococcus* » *parietinarius* (Linds.) Clauz. et Roux, dont la position systématique est incertaine (voir Roux et Triebel 1994: 538-539), parasite le thalle et les apothécies de *Xanthoria parietina* et diffère de *P. clauzadei* par son caractère non cécidiogène, par des ascomes (60–100 µm × 50–100 µm), des asques (35-48 × 10-16 µm, octosporées) et des spores (10,5)11–13(14) × (4)4,5–5,5(6) µm plus petits, par des hyphes végétatives bien visibles, etc.

Polycoccum clauzadei, par son caractère cécidiogène et ses spores fortement ornées, rappelle *P. pulvinatum* (Eitner) R. Sant. (= *P. galligenum* Vězda) (Vězda 1969, Hawksworth 1975, Hawksworth et Diederich 1988; Clauzade et Roux 1976, Clauzade et al. 1989), qui parasite diverses espèces de *Physcia. P. clauzadei* se distingue de *P. pulvinatum* (tableau) par un hôte différent, chez lequel il forme des cécidies plus petites, par des ascomes et des asques un peu plus petits et par des spores généralement par 4-6 dans les asques. Les spores ont des dimensions semblables chez les deux espèces, mais leur forme est différente: chez *P. clauzadei,* les spores sont hétéropolaires et, pour la plupart, obovoïdes ou soléiformes, tandis qu'elles sont homopolaires et ellipsoïdales ou oblongues-ellipsoïdales chez *P. pulvinatum* (cf. fig. 6 et 7 du présent travail; Hawksworth 1975: fig. 11 b; Hawksworth et Diederich 1988: fig. 1 g; Vězda 1969: fig. 2).

Si l'on fait abstraction du caractère cécidiogène et si l'on ne considére

	P. clauzadei	*P. pulvinatum*	*P. microsticticum*
Cécidies	(0,2)0,4-0,8 mm	(0,5)1-3 mm	absentes
Ascomes	(120)140-190 µm × (110)120-180 µm	150-300 µm × 145-200 µm	100-150 µm de diamètre
Asques	(45)50-70(80) × 13-15 µm, 4-6(8)-sporés	(60)65-75(80) × 15-18 µm, (4)8-sporés	65-90 × 10-12 µm 4-8-sporés
Ascospores	obovoïdes ou soléiformes, hétéropolaires, 15-18,5(19,5) × (6,5)7-9(9,5) µm	ellipsoïdales ou oblongues-ellipsoïdales, homopolaires, 14-21 × 6-9 µm	ellipsoïdales, homopolaires ou presque, 14-18 × 7-8,5 µm
Hôte	*Xanthoria elegans*	*Physcia* spp.	*Acarospora fuscata, A.* sp., *Buellia stellulata,* (?) *Rhizocarpon* sp.

Tableau – Principaux caractères distinctifs de *Polycoccum clauzadei, P. pulvinatum* et *P. microsticticum.*

que la structure des ascomes, des asques et des spores, *P. clauzadei* présente également des affinités avec *P. microsticticum* (Leight. ex Mudd) Arnold, qui, d'après la littérature, se rencontre sur divers lichens crustacés: *Acarospora fuscata*, *Acarospora* sp. (hôte-type), *Buellia stellulata* et, avec doute, *Rhizocarpon geographicum* (cf. Hawksworth et Diederich 1988). *P. clauzadei* et *P. microsticticum* ne diffèrent pas sensiblement par la taille de leurs ascomes et ascospores, mais, d'après Hawksworth et Diederich (1988) et Vouaux (1913), *P. microsticticum* a des asques légèrement plus longs et nettement plus étroits (65–90 × 10–12 µm) et des spores typiquement ellipsoïdales.

La nature de l'hôte, l'induction de cécidies, les différences dans les dimensions des ascomes et des asques et, principalement, la forme des ascospores, constituent des caractères suffisants pour considérer *P. clauzadei* comme une espèces distincte des deux *Polycoccum* dont il se rapproche le plus, *P. pulvinatum* et *P. microsticticum.*

Répartition et écologie

Polycoccum clauzadei est connu seulement par le matériel type (Buoux, massif du Grand Luberon, Vaucluse, SE de la France), parasite du thalle de *Xanthoria elegans* sur les tuiles du toit d'une bastide.

Autre espèce étudiée pour comparaison

***Polycoccum pulvinatum* (Eitner) R. Sant.**

The lichens and lichenicolous fungi of Sweden and Norway : 175 (1993).

Bas.: *Tichothecium pulvinatum* Eitner, *78 Jahresber. d. Schles. Ges.* 1900 : 26 (1901).

Syn.: ***Polycoccum galligenum*** Vězda, *Česká Mykol.* **23** : 107 (1969).

Matériel étudié

Espagne.- Prov. de Castellón, Azuebar, Bco. Mosquera, U.T.M. 30SYK2517, alt. 620 m, arenisca no carbonatada, 1992/03/14. Leg. V. Calatayud (VAB-lich. 7824). Parasite de *Physcia tribacea* (Ach.) Nyl.

Description sommaire

Cécidies très convexes ou hémisphériques, de (0,5)1–3 mm de diamètre. **Ascomes** périthécioïdes (pseudothèces), de 160–220 × 145–200 µm, subglobuleux. **Asques** de (60)65–75(80) × 15–18 µm, cylindriques-claviformes, la plupart octosporés, rarement tétrasporés. **Ascospores** (Fig. 7) de 15,5–*17,7*–20,5 × 6–*7,1*–8(9) µm, à rapport

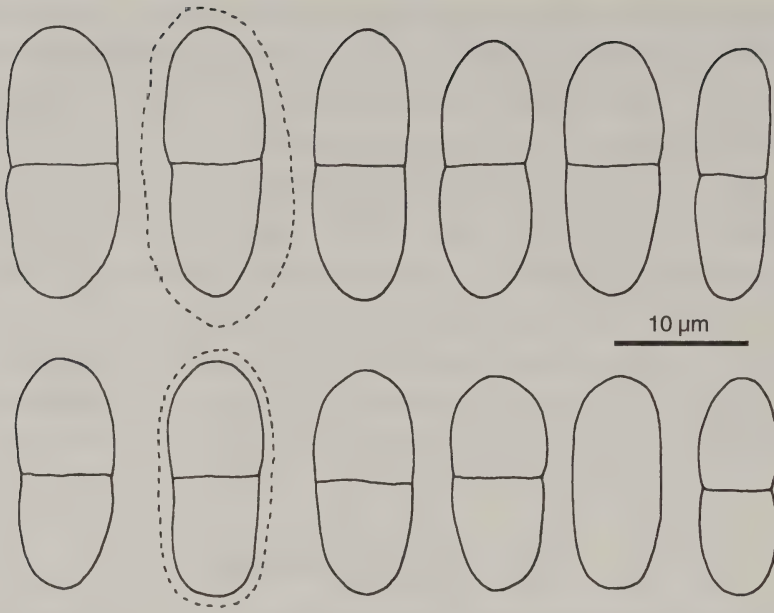


Fig. 7.— *Polycoccum pulvinatum.* Variabilité de la forme des ascospores (observées dans l'eau ; pigmentation et ornamentation non representées).

longueur sur largeur de 2,1–*2,5*–2,7(3,2) [18 spores mesurées], d'ellipsoïdales à oblongues–ellipsoïdales, non resserrées à la cloison, à périspore gélatineuse, qui, à maturité, devient densément rugueuse-verruqueuse.

Remerciements

Nous remercions bien vivement nos amis A. Bellemère (Puteaux), P. Diederich (Luxembourg), X. Llimona (Barcelona), qui ont revu notre manuscrit, et V. Calatayud (Valencia) pour le prêt du spécimen de *Polycoccum pulvinatum.*

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MYCOTAXON

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DISCOMYCETES OF TROPICAL CHINA. II COLLECTIONS FROM YUNNAN*

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ABSTRACT Eight-two taxa belonging to 43 genera from tropical Yunnan are reported. Among them, *Acervus xishuangbannicus, Octospora yunnanica* and *Scutellinia sinosetosa* are described as new species. *Coprobia elaphorum* is transferred to *Cheilymenia* and *Dasyscyphus brevipilus* to *Lachnum*. Thirteen species are recorded for the first time from China. Habitat, collecting season, and specific localities of species discovered are provided.

Yunnan Province is located in the southwest of China. The tropical areas of Yunnan where collections for this study were made to the south of 23.5 N including Cheli (Jinghong), Endangered Plant Collections (Menglun), Limestone Hill (Menglun), Luchun, Mengla, Menglun, Pu'er, Road from Mengyang to Xishuangbanna Botanic Garden (Menglun Natural Reserve), Simao, Wenshan, Xichou, and Xishuangbanna Botanic Garden (Menglun) (Fig. 1) at the altitude of 520-700 m. Previous records of discomycetes from these regions are attributed to Teng (1934, 1935, 1963, 1996), Tai (1944, 1979), Korf & Zhuang (1985), Zhuang (1990a, b, 1991, 1994, 1996), Wang (1997), and Zhuang & Wang (1997, 1998). This study is based on specimens collected in Xishuangbanna areas in October of 1988 and those on deposit in the Herbarium Mycologicum Instituti Microbiologici Academiae Sinicae (HMAS) and Herbarium of Cryptogams, Kunming Institute of Botany, Academia Sinica (HKAS). Following the name of each species, habitat, collecting time, specific localities, and specimens observed are indicated. Chinese names are provided only for new species and new records of China. Eighty-two taxa belonging to 43 genera are found. New species are described in *Acervus* Kanouse, *Octospora* Hedw. and *Scutellinia* (Cooke) Lambotte. *Coprobia elaphorum* (Rehm) Boud. is transferred to *Cheilymenia* Boud. and *Dasyscyphus brevipilus* to *Lachnum* Retz. Thirteen species are recorded for the first time from China, which are marked with an asterisk (*).

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Fig. 1 Map of tropical areas in Yunnan Province, showing collecting sites.

Acervus epispartius (Berk. & Broome) Pfister forma **epispartius**, Farlow Herb. Crypt. Bot. 8: 3, 1975.
On soil. Collected in October.
Menglun: HKAS 22054.

Acervus epispartius forma **albus** Korf & W. Y. Zhuang, Mycotaxon 35: 297, 1989.
On bare soil and duff. Collected in October.
Endangered Plant Collections: HMAS 57686, CUP-CH 2534.

Acervus xishuangbannicus W. Y. Zhuang & Z. Wang, **sp. nov.** (Fig. 2)
版纳小孢盘菌

Ab *Acervo flavido* ascosporis crassis, 12.5-13.5 x 9.0-10.0 μm, ascis 150-181 x 10-15 μm, paraphysibus 4.5-6.0 μm latis differt.

Apothecia deeply cupulate when young, subturbinate to discoid at maturity, stipitate, up to 5 mm in diam when dry, 3-5 mm high when fresh; hymenium egg yolk yellow, receptacle yellow, surface of receptacle and stipe furry, with subiculum at stipe base. Ectal excipulum of textura angularis, 100-140 μm thick; cells subellipsoid,

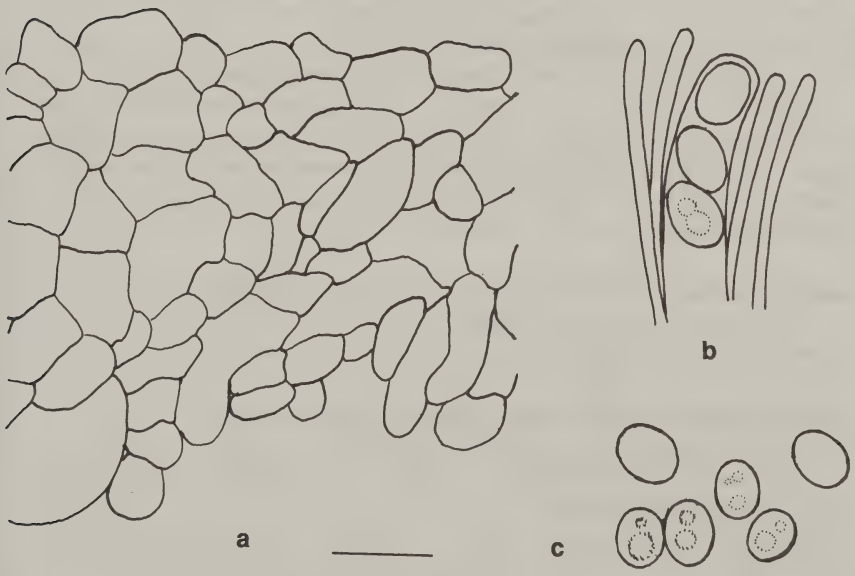


Fig. 2 *Acervus xishuangbannicus*: **a**. Ectal excipulum; **b**. Ascus and paraphysis apices; **c**. Ascospores. Scale = 20 μm. From HMAS 72125.

elongate or nearly isodiametric, hyaline, thin-walled, with dense cytoplasm, up to 38 x 30 μm. Medullary excipulum of textura intricata, 150-350 μm thick; hyphae hyaline, thin-walled, mostly 4-11 μm wide, mixed with large cells up to 33 x 18 μm. Subhymenium not distinguishable. Hymenium 150-160 μm thick. Asci 8-spored, subcylindrical, J- in Melzer's reagent, 150-181 x 11-15 μm. Ascospores uniseriate, broadly ellipsoid, biguttulate, hyaline, thick-walled, 12.5-13.5 x 9.0-10.0 μm. Paraphyses subcylindrical, 4.5-6.0 μm wide.

Holotype: on very rotten wood, Limestone Hill, Xishuangbanna, Yunnan, China, alt. 650m, R. P. Korf, M. Zang, K. K. Chen & W. Y. Zhuang (219), 22 X 1988, HMAS 72125.

This fungus is distinguished from existing taxa of *Acervus* Kanouse (Pfister, 1975, 1985; Korf & Zhuang, 1985) in ascospores very broadly ellipsoid, thick-walled, 12.5-13.5 x 9.0-10.0 μm, asci 150-181 x 11-15 μm, and paraphyses 4.5-6.0 μm wide.

* **Acervus** cf. **flavidus** (Berk. & M. A. Curtis in Berk.) Pfister, Farlow Herb. Crypt. Bot. 8: 5, 1975. 黄小孢盘菌

Apothecia discoid, subsessile, up to 8 mm in diam; hymenium yellow when young, discoloring to pinkish; receptacle whitish, somewhat hairy. Ectal excipulum of textura angularis to textura globulosa, cells very thin-walled, isodiametric, up to 10-18 μm in diam. Medullary excipulum of textura intricata, hyphae hyaline, very thin-walled. Hymenium 160-170 μm thick. Asci 8-spored, subcylindrical, J- in Melzer's reagent, 124-152 x 7.5-10.5 μm. Ascospores ellipsoid, biguttulate, hyaline, not thick-walled, 10.5-12.5 x 6.0-7.5 μm. Paraphyses subcylindrical, ca 3 μm wide.

On rotten roots. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72133.

This is certainly new in the genus *Acervus* Kanouse. It differs mainly from *Acervus flavidus* (Berk. & M. A. Curtis) Pfister (1975) in wider ascospores which are regularly ellipsoid and 10.5-12.5 x 6.0-7.5 μm instead of outline regularly to irregularly ellipsoid and (7.5-)9-13 x 5 x 5.7 μm. The material is too poor to be a type. We temporarily treat it as *Acervus* cf. *flavidus*.

Ascobolus cervinus Berk. & Broome, J. Linn. Soc. Bot. 15: 85, 1876.

On deer dung. Collected in November.

Menglun: HMAS 72009 (ex HKAS 22179).

Ascobolus scatigenus (Berk.) Brumm., Persoonia Suppl. 1: 159, 1967.

On buffalo dung and cow dung. Collected in October.

Menglun: HKAS 22055, HMAS 72010; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72149.

Ascobolus sp.

On cow dung. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72157.

Apothecia of this fungus are turbinate, white and up to 2 mm in diam. Asci are diffusely blue in Melzer's reagent. Ascospores are 32-36 x 14.5-16.5 μm, permanently hyaline, and with transverse wrinkles on surface when old. Paraphyses are enlarged and up to 10 μm at apex. This should be a member of *Ascobolus* Pers. but it is impossible to give it a suitable name since spore ornamentation cannot be seen.

Ascocoryne sarcoides (Jacq. : Fr.) Groves & Wilson, Taxon 16: 40, 1967.

On wet rotten wood. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72158.

* **Aurophora dochmia** (Berk. & M. A. Curtis) Rifai, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 57(3): 52, 1968. 耳盘菌

On rotten twigs. Collected in August.

Menglun: HKAS 21473, HMAS 71974.

As indicated by Rifai (1968), *Aurophora* Rifai is distinguished from *Phillipsia* Berk. mainly in the ear-shaped ascocarps and presence of gelatinous tissues in the medullary excipulum. Morphology of the Chinese material is identical with that of the Australasian collection.

Bisporella clavoflava (Grev.) Lizon & Korf, Mycotaxon 54: 474, 1995.

On dead bark and ?herbaceous stem. Collected in October.

Limestone Hill: 72120; Menglun: HMAS 72119.

Bulgaria inquinans (Pers. : Fr.) Fr., Syst. Mycol. 2: 167, 1822.

On withered twig. Collected in May.

Xichou: HMAS 27632.

Calycellinopsis xishuangbanna W. Y. Zhuang, Mycotaxon 38: 121, 1990.

On petioles. Collected in October.

Limestone Hill: HMAS 58722.

* **Cheilymenia elaphorum** (Rehm) W. Y. Zhuang & Z. Wang, **comb. nov.** 鹿缘刺盘菌

≡ *Humaria elaphorum* Rehm, in Rabenh., Krypt.-Fl. III[Lief. 42]: 945, 1894.

≡ *Coprobia elaphorum* (Rehm) Boud., Hist. Class. Discom. Eur. p. 69, 1907.

On buffalo dung and cow dung. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72151, 72152, 72153.

The morphology of the Chinese collections is identical with that described by Thind and Kaushal (1978) from India. Following the treatment by Moravec (1990), *Coprobia* Boud. is treated as a synonym of *Cheilymenia* Boud. We transfer *Coprobia elaphorum* to the genus *Cheilymenia*.

Chlorociboria aeruginosa (Pers. : Fr.) Seaver ex C. S. Ramamurthi, Korf & L. R. Batra, Mycologia 49: 859, 1958.

On green-stained wood. Collected in May and October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72127; Xichou: HMAS 26082.

Chlorosplenium chlora (Schwein. : Fr.) M. A. Curtis in Sprague, Proc. Boston Soc. Nat. Hist. 5: 330, 1856.

On hard rotten wood. Collected in May.

Simao: HMAS 24109.

Ciboria peckiana (Cooke) Korf, Phytologia 21: 203, 1971.

On wood. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 58763.

Cookeina indica Pfister & R. Kaushal, Mycotaxon 20: 117, 1984.

On wood and twigs. Collected in August, September and October.

Limestone Hill: HKAS 1092, 21452, 23161, 23295; Mengla: HKAS 26364; Menglun: HKAS 1142, 1273, 28580; Road from Mengyang to Xishuangbanna Botanic Garden: HKAS 21453, 23997, HMAS 70087, 70102, 71972; Xishuangbanna Botanic Garden: HKAS 21449, 21450, 21451, 23112.

Cookeina insititia (Berk. & M. A. Curtis) Kuntze, Rev. Gen. Pl. 2: 849, 1891.

On rotten wood. Collected in June, August, September, October and November.

Endangered Plant Collections: HKAS 22060, HMAS 70078; Limestone Hill: HMAS 71945, 72075; Luchun: HKAS 253, HMAS 70320; Menglun: ex HKAS 17940; Mengyang: HKAS 7256, HMAS 70319; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 70076, 71946, 72076, 72077, 72078; Xishuangbanna: HKAS 7240, 7256, 20380.

Cookeina sinensis Z. Wang, Mycotaxon 62: 296, 1997.

On twigs and rotten wood. Collected in June, August, September and October.

Limestone Hill: HKAS 21458, 23233, HMAS 71975; Mengla: HKAS 27196; Menglun: HKAS 14679, 17940, HMAS 71871, TNM-F 3710; Road from Mengyang to Xishuangbanna Botanic Garden: HKAS 21459, 21460, 23994, 23995, HMAS 71976; Xishuangbanna Botanic Garden: HMAS 70088.

Cookeina speciosa (Fr. : Fr.) Dennis, Mycotaxon 51: 237, 1995.

On rotten wood and twigs. Collected in July through November.

Endangered Plant Collections: HMAS 70079; Menglun: HKAS 1015, 1297, 1437, ex 17935, HMAS 61346, 71818; Xishuangbanna Botanic Garden: HKAS 22058, 26372; Xishuangbanna: HKAS 26492, HMAS 27634, 27652, 71818, 71887.

Cookeina tricholoma (Mont.) Kuntze, Rev. Gen. Pl. 2: 849, 1891.

On rotten wood and twigs. Collected in June, August and September.

Endangered Plant Collections: HKAS 22064, 23238; Mengla: HKAS 17935, 21893, HMAS 62988, 71977; Menglun: HKAS 17935, HMAS 61348, 71977; Xishuangbanna Botanic Garden: HKAS 21457; Xishuangbanna: HMAS 27649, 70077, 70081, 71883.

* **Coprotus lacteus** (Cooke & W. Phillips) Kimbr., Luck-Allen & Cain, Can. J. Bot. 50: 965, 1972. 乳粪裸盘菌

On deer dung. Collected in October.

Menglun: HKAS 22179.

The fruitbodies of this species are discoid, sessile, and 0.4-0.8 mm in diam when dry. Ascospores are elongate-ellipsoid, uniseriate to biseriate, 9-12 x 4.0-5.2 μm, and often with a de Bary bubble. The Chinese collection has narrower spores than the Indian ones [4.0-5.2 μm wide vs. 6-7(-8) μm wide] (Thind et al., 1978).

Dicephalospora rufocornea (Berk. & Broome) Spooner, Bibl. Mycol. 116: 272, 1987.

On rotten bark and twigs. Collected in August, September and October.

Endangered Plant Collections: HMAS 72130; Limestone Hill: HMAS 58726, 68508, 68509, 72128; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72129, 72174; Wenshan: HMAS 17082; Xishuangbanna: HMAS 68954.

Encoelia helvola (Jungh.) Overeem, Icones Fung. Malayen. p. 1, 1926.

On cankers at internodes of living bamboo plants. Collected in October.

Endangered Plant Collections: HMAS 54037.

Galiella javanica (Rehm) Nannf. & Korf, Mycologia 49: 108, 1957.

On rotten wood. Collected in May.

Xichou: HMAS 27511, 27739, 27740.

Geoglossum glutinosum Pers. : Fr., Obs. Mycol. 1: 11, 1796.

On the ground. Collected in August.

Cheli: HMAS 4052, 4053, 4054, 4064.

Hymenoscyphus caudatus (P. Karst.) Dennis, Persoonia 3: 76, 1964.

On stromatized midrib of leaf. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 68507.

Lachnum abnorme (Mont.) J. H. Haines & Dumont, Mycotaxon 19: 10, 1984.

On rotten wood and bark. Collected in April, May, June.

Simao: HMAS 24251, 24252, 24253, 26544, 27667, 27668, 27671; Xichou: HMAS 33712, 33713, 33793.

Lachnum brasiliense (Mont.) J. H. Haines & Dumont, Mycotaxon 19: 23, 1984.

On bark of branch and rotten wood. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72147; Xishuangbanna Botanic Garden: HMAS 72146.

* **Lachnum** cf. **euterpes** S. A. Cantrell & J. H. Haines, Mycol. Res. 101: 1081. 1997.
棕榈粒毛盘菌

Apothecia discoid, stipitate, from less than 1 mm to 2 mm in diam; hymenium pinkish to reddish; receptacle ivory to white, surface hairy. Hairs granulate, hyaline, thin-walled, less than 100 μm long. Asci clavate, J+ in Melzer's reagent, 65-80 x 4.5-6.0 μm. Ascospores fusoid with pointed ends, hyaline, multiguttulate, showing a dark-stained area in the middle when mounted in cotton blue solution, 18-22 x 1.5-2.5 μm. Paraphyses lanceolate, 2.0-2.8 μm wide.

On twigs. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72142, 72143.

This is a very distinct species of pinkish to reddish apothecia. Ascospores are with a dark-stained area in the middle. Morphology of the Chinese collections is similar to *Lachnum euterpes*, a red species (Cantrell & J. H. Haines, 1997), whereas the host is entirely different, asci longer and narrower (65-80 x 4.5-6.0 μm vs. 50-65 x 6.0-7.5 μm), and spores are longer and narrower [18-22 x 1.5-2.5 μm vs. (13-)15-18(-20) x 2.5-3.5 μm].

* **Lachnum sp.** cf. **Lachnum legalii** W. Y. Zhuang & Z. Wang, **nom. nov.** (Fig. 3)
盖尔粒毛盘菌

≡ *Dasyscyphus brevipilus* Le Gal, Rev. Mycol. N. S. 4: 26, 1939.
(Non *Lachnum brevipilum* (Hoehn.) Nannf., Nova Acta Regiae Soc. Upsal. ser. 4, 8(2): 262, 1932. ≡ *Dyslachnum brevipilum* Hoehn., Mitteil. Bot. Lab. Techn. Hochsch. Wien II(3): 117, 1926.)

On bark. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72154, 72155.

Apothecia of this fungus are discoid, long-stipitate, and less than 1 mm in diam, hymenium ivory to white; hairs are clavate, wider at upper two cells and narrower below, hyaline, with 3-5 septa, slightly pointed apex and granules distributed more on upper two cell surface than on cells below, 50-77 x 3.0-4.5 μm wide; ectal excipulum are of textura prismatica and 27-55 μm thick; paraphyses are slightly lanceolate, 1.5-2.5 μm wide at the widest. It differs from typical *Dasyscyphus brevipilus* (Dennis, 1949) in hairs somewhat pointed at tip, granules on hair surface distributed densely on upper cells and fewer on the lower ones, asci larger (50-62 x 6.0-8.5 μm vs. 45-50 x 4-5 μm), and ascospores wider [6.5-8.5 x 2.4-3.0 μm vs. 6-8(-11) x 1.5-2.5 μm]. Since *Lachnum* references available by hand are not sufficient to find a suitable name for it, we temporarily treat it as *Lachnum* sp. cf. *Lachnum legalii*.

Lachnum pteridophyllum (Rodw.) Spooner, Bibl. Mycol. 116: 470, 1987.
蕨粒毛盘菌



Fig. 3 *Lachnum legalii*: **a**. Hairs; **b**. Ascus and ascospores. Scale = 10 μm. From HMAS 72154.

On twigs. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72148.

Morphology of the Chinese material fits well *Lachnum pteridophyllum* (Spooner, 1987). Host of this fungus is definitely not a pteridophyte. It is the first time that species is found in the mainland of China.

Lachnum sclerotii (A. L. Smith) J. H. Haines & Dumont, Mycotaxon 19: 17, 1984.

On twigs, branches, bark, herbaceous stems and living wood. Collected in October.

Endangered Plant Collections: HMAS 72138, 72139, 72140; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72134, 72135, 72136, 72137, 72141.

Lachnum virgineum (Batsch : Fr.) P. Karst., Mycol. Fenn. 1: 169, 1871.

On stems of *Rubus*. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72144, 72145.

Lambertella aurantica V. P. Tewari & D. C. Pant, Mycologia 59: 120, 1967.

On veins, midribs and petioles of leaves. Collected in October.

Limestone Hill: HMAS 68726; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 58727, 58728, 58729; Xishuangbanna Botanic Garden: HMAS 58724, 58725.

Lambertella copticola Korf & Tewari, Mycologia 55: 598, 1963.

On line stromata on leaves. Collected in August.

Wenshan: HMAS 17061, 17062.

The medullary excipulum of the Yunnan collections turned blue in Melzer's reagent, which recalls the fungus collected from Sichuan Province (Korf & Zhuang, 1985).

Lambertella jasmini Seaver, Whetzel & Dumont, Mem. N. Y. Bot. Gard. 22(1): 75, 1971.

On stromatized petals. Collected in October.

Xishuangbanna Botanic Garden: HMAS 58731.

Lambertella korfii W. Y. Zhuang, Mycotaxon 39: 480, 1990.

On stromatized petioles. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 58733, 58734, 58735, 58736, 58737, 58738, 58739, 58740, 58741.

Lambertella tewari Dumont, Mem. N. Y. Bot. Gard. 22(1): 146, 1971.

On stromatized leaves. Collected in October.

Xishuangbanna Botanic Garden: HMAS 58742, 58743.

Lambertella verrucosispora W. Y. Zhuang, Mycotaxon 39: 483, 1990.

On stromatized ? petioles. Collected in October.

Limestone Hill: HMAS 58744; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 58745.

Lambertella xishuangbanna W. Y. Zhuang, Mycotaxon 39: 484, 1990.

On stromatized veins, veinlets and leaf blades with line stromata. Collected in October.

Limestone Hill: HMAS 58746, 58747, 58748, 58749, 58750; Menglun: HMAS 72126; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 58751.

Lanzia serotina (Pers. : Fr.) Korf & W. Y. Zhuang, Mycotaxon 22: 506, 1985.

On stromatized leaves. Collected in October.

Xishuangbanna: HMAS 58723.

Microglossum longisporum E. J. Durand, Ann. Mycol. 6: 409, 1908.

On the ground. Collected in June and August.

Cheli: HMAS 3422, 3423, 4051; Menglun: HKAS 21471; Simao: HMAS 69547.

Microstoma floccosum (Schwein.) Raitv., Eesti NSV Tead. Akad. Toim., Bilol. ser. 14: 529, 1965.
On rotten twig. Collected in November.
Simao: CUP-CH 254.

Moellerodiscus lentus (Berk. & Broome) Dumont, Mycologia 68: 245, 1976.
On leaves. Collected in October.
Xishuangbanna: HMAS 58764, 58765.

Nanoscypha pulchra Denison, Mycologia 64: 620, 1972.
On twig of *Platycladus orientalis*. Collected in October.
Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 70128.

Octospora yunnanica W. Y. Zhuang & Z. Wang, **sp. nov.** (Fig. 4) 云南八孢盘菌

Ab *Octospora alpestris* ascis octosporis, grandibus, 237-280 x 13.5-16.5 μm, paraphysibus latis, ascosporis 17-18 x 9-10.5 μm, tuberculis ascosporarum magnis, 1.5-2.5 x 1.5-2.5(3.0) μm differt.

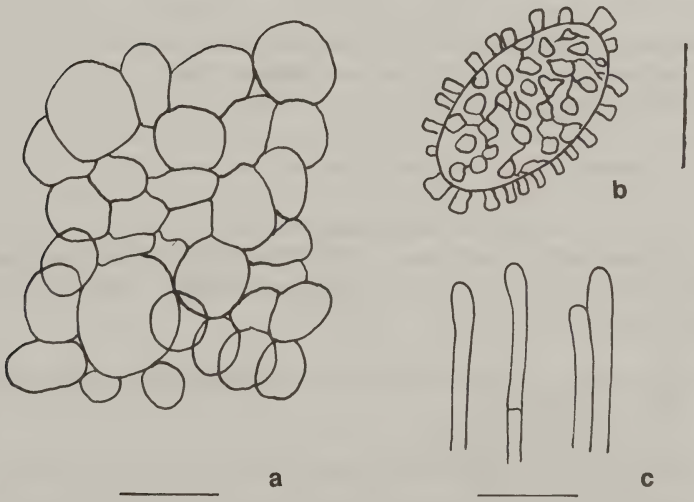


Fig. 4 *Octospora yunnanica*: **a**. Ectal excipulum, scale = 20 μm; **b**. An ascospore, scale = 10 μm; **c**. Paraphysis apices, scale = 20 μm. From HMAS 72160.

Apothecia discoid, margin incurved, sessile, ca 2 mm in diam, hymenium tan. Ectal excipulum of textura angularis, 143-280 μm thick, outer surface somewhat pustulate; cells hyaline, thin-walled, 9-15 x 9-20 μm. Medullary excipulum of textura intricata mixed with textura angularis, ca 80-100 μm thick; cells and hyphae hyaline, thin-walled. Hymenium ca 210-220 μm thick. Asci 8-spored, J- in Melzer's reagent, 237-280 x 13.5-16.5 μm. Ascospores uniseriate, ellipsoid, uniguttulate to biguttulate, with subcylindrical markings that may be broader above than below, 17-18 x 9-10.5 μm excluding ornamentations; spore ornamentations sometimes interconnected by fine crests, 1.5-2.5 μm high and 1.5-2.5(-3.0) μm wide, larger and higher at both ends. Paraphyses slightly swollen at apex, 5.5-7.5 μm wide at apex and 2.8-3.5 μm below.

Holotype: on bare soil, 55 km mark in road from Mengyang to Xishuangbanna Botanic Garden, R. P. Korf, M. Zang, K. K. Chen & W. Y. Zhuang (241), 23 X 1988, HMAS 72160.

Caillet & Moyne (1987) provided descriptions of species in the genus *Octospora* Hedw. The Yunnan collection is close to *Octospora alpestris* in shape and size of ascospores and presence of spore ornamentations but differs significantly from that species in shape and size of spore markings which are large and subcylindrical, 1.5-2.5 μm high and 1.5-2.5(-3.0) μm wide; 8-spored, much longer and wider asci; and wider paraphyses. A recently published species, *Octospora kilimanjarensis* Moravec (1997) which has large ornamentations on the spore surface, differs from *Octospora yunnanica* in spore size, shape of spore markings, and presence of thick-walled hairs on receptacle surface.

Orbilia auricolor (Bloxam ex Berk. & Broome) Sacc., Syll. Fung. 8: 625, 1889.

On fibers of inner hulls of a fruit. Collected in October.

Xishuangbanna Botanic Garden: HMAS 72163.

Orbilia inflatula (P. Karst.) P. Karst., Not. Sallsk. Fauna Fl. Fenn. Forh. 11: 248, 1870.

On rotten wood and bark. Collected in October.

Endangered Plant Collections: HMAS 72164, 72165, 72166; Menglun: HMAS 72168; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72167, 72169, 72170, 72172.

* **Pachyella babingtonii** (Berk. & Broome) Boud., Hist. Class. Discom. Eur. p. 51, 1907. 巴氏厚盘菌

On wet wood. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72159.

Pfister (1973) provided detailed description of this species. The apothecia are gelatinous, flat, and very broadly attached to the substrate.

* **Pezicula** cf. **rubi** (Libert) Niessl in Rabenh. Fungi Eur. p. 2122, 1876. 悬钩子无柄盘菌

On bark of *Tetrastigma* sp. Collected in October.

Limestone Hill: HMAS 72165.

The host of HMAS 72165 differs from that of typical material (Dennis, 1974). Para-physes are 1.5-2.5 μm wide and ascospores brown, 3-septate, and 16-24 x 5.5-7.0 μm.

Peziza cf. **repanda** Pers., Mycol. Eur. 1: 231, 1822.

On soil at burnt site. Collected in October.

Xishuangbanna Botanic Garden: HMAS 72124.

Ascospores are larger than those described by Dennis (1968) (16.5-20.0 x 9.5-11.0 μm vs. 15-16 x 9-10 μm).

* **Phaeohelotium** cf. **subcarneum** (Schumach. ex Sacc.) Dennis, Kew Bull. 25: 355, 1971. 亚肉色暗柔膜菌

Apothecia discoed, sessile, up to 0.6 mm in diam, margin faintly crenate, hymenium dirty white. Ectal excipulum of textura prismatic to textura angularis, ca 20 μm wide, outer cells with a swollen and rounded end. Medullary of textura intricata, 30-40 μm thick. Hymenium 55-57 μm thick. Asci 8-spored, J+ in Melzer's reagent, pore walls very faintly blue, difficult to detect, ca 50 x 5 μm. Ascospores ellipsoid, biseriate, hyaline, mostly biguttulate, 7.5-8.0 x 2.7-3.0 μm. Paraphyses subcylindrical, 1.5 μm wide.

On herbaceous stem. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72171.

Structurally, the Xishuangbanna collection is similar to species in the genus *Phaeohelotium* Kanouse. When compared with species of the genus recorded by Dennis (1978), the Yunnan collection is similar to *Phaeohelotium subcarneum* but differs in apothecia dirty white instead of pale purplish pink, asci smaller (ca 50 x 5 μm vs. 70 x 8 μm), ascospores smaller [7.5-8.0 x 2.7-3.0 μm vs. 9-12(-13) x 2.5-4.0 μm], and paraphyses subcylindrical instead of swollen up to 3 μm at the obtuse tip.

Phillipsia carnicolor Le Gal, Prodr. Fr. Mycol. Madagascar 4: 281, 1953.

On rotten wood and twigs. Collected in August and October.

Menglun: HKAS 1016, HMAS 70312; Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 70083, 70084; Xishuangbanna: HMAS 71899, TNM-F 3705, 3711.

Phillipsia costaricensis Denison, Mycologia 61: 300, 1969.

On rotten twig. Collected in August.

Road from Mengyang to Xishuangbanna Botanic Garden: TNM-F 3707.

Phillipsia domingensis (Berk.) Berk., J. Linn. Soc. Bot. 18: 388, 1881.

On rotten wood and twigs. Collected in August and October.

Limestone Hill: HKAS 21472, 23294, HMAS 71944, 71973, 72074; Xishuangbanna: HMAS 70116; Road from Mengyang to Xishuangbanna Botanic Garden: HKAS 24015, HMAS 70117.

* **Phillipsia hartmannii** (W. Phillips) Rifai, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 57(3): 50, 1968. 哈特曼歪盘菌

On rotten twig. Collected in august.

Endangered Plant Collections: HKAS 23305, HMAS 71951.

* **Phillipsia umbilicata** (Penz. & Sacc.) Boedijn, Bull. Jard. Bot. Buit. ser. III, 16: 365, 1940. 脐状歪盘菌

On rotten twigs. Collected in September.

Road from Mengyang to Xishuangbanna Botanic Garden: HKAS 22751, 22752, HMAS 71950.

Plectania campylospora (Berk. in Hooker) Korf, Mycologia 49: 110, 1957.

On rotten wood. Collected in November.

Menglun: HKAS 20528.

Psilopezia juruensis Henn., Hedwigia 43: 273, 1904. 耶地滑盘菌

On wood. Collected in August.

Menglun: HKAS 24018.

This is recorded for the first time from the mainland of China.

Saccobolus truncatus Velen., Monogr. Discom. Boh. 1: 370, 1934.

On cow dung. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 72150.

Scutellinia scutellata (L. : Fr.) Lambotte, Fl. Mycol. Belge, Suppl. 1: 299, 1887.

On rotten wood. Collected in April.

Simao: HMAS 30781.

Scutellinia sinosetosa W. Y. Zhuang & Z. Wang, **sp. nov.** (Figs.5, 6) 华刚毛盾盘菌

Ab *Scutellinia setosa* ascospores reticulatis, 16-22 x 11-13 μm differt.

Apothecia discoid, sessile, 1-2.5 mm in diam; hymenium orange-brown to orange, receptacle brown, with brown setae. Setae brown, thick-walled, stiff, with 1-4(-5) rootlets, 3-5-septate, 115-560(-775) x 15-30 μm, walls 4-6 μm thick; in-between setae presence of short, subhyaline, thin-walled, not stiff, 8-13 μm wide, blunt-apexed hairs. Ectal excipulum of textura angularis, 75-200 μm thick; cells subhyaline, thin-walled, 18-89 x 13-71 μm. Medullary excipulum of textura intricata, 75-150 μm thick. Hymenium 266-280 μm thick. Asci 8-spored, subcylindrical, J- in Melzer's reagent, ca 225-235 x 10-13 μm. Ascospores ellipsoid, biguttulate, surface with delicate fine warts and crests which are not clearly detected under the light microscope and as incomplete reticula in SEM study, 16-22 x 11-13 μm. Paraphyses slightly enlarged at apex, 4-8 μm at apex and 3-3.5 μm below.

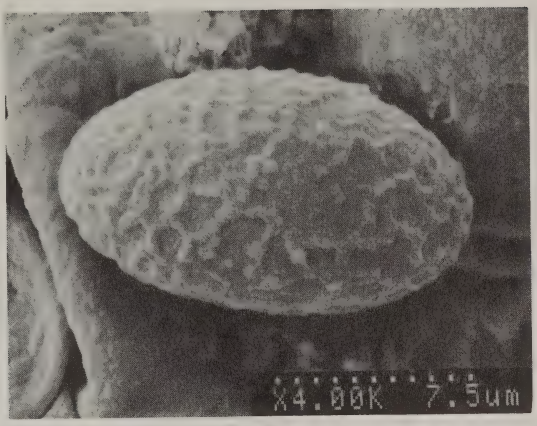


Fig. 5 SEM photograph of ascospore, scale = 7.5 μm. From hologype.

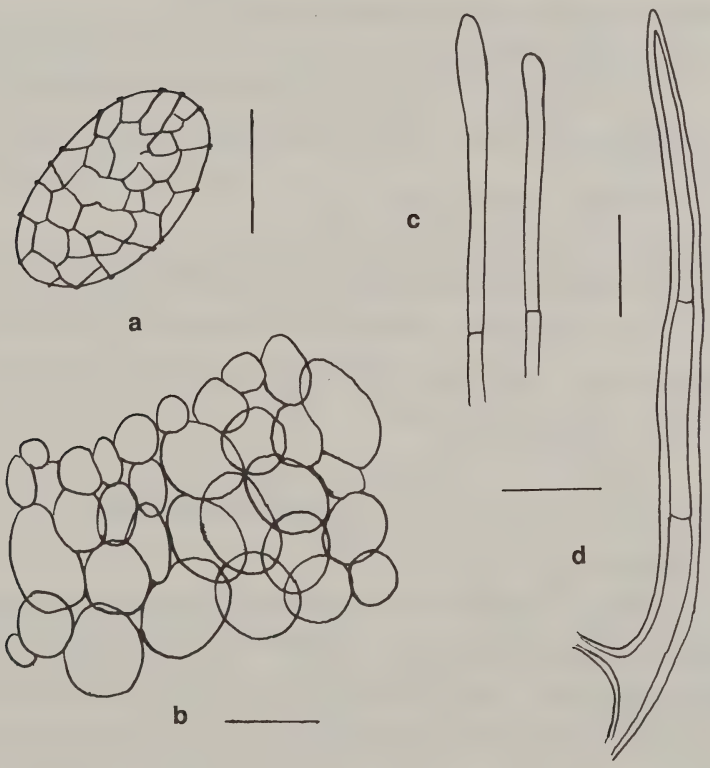


Fig. 6 *Scutellinia sinosetosa*: **a**. An ascospore, scale = 10 μm; **b**. Ectal excipulum, scale = 50 μm; **c**. Paraphysis apices, scale = 20 μm; **d**. A hair, scale = 20 μm;. From HMAS 61436.

Holotype: on wet wood, 53 km mark of road from Mengyang to Xishuangbanna Botanic Garden, Yunnan, China, alt. 600 m, M. Zang, R. P. Korf, K. K. Chen & W. Y. Zhuang 300, 24 X 1988, HMAS 61436.

Paratypes: on rotten wood, Mei County, Shaanxi, S. J. Zhang 755, 19 IX 1958, HMAS 31031; on wood, 2.5 km from Baishui to Heishui, Lijiang, Yunnan, alt. 3000 m, R. P. Korf, L. S. Wang & W. Y. Zhuang 370, 3 XI 1988, HMAS 61437.

When Zhuang (1994) recorded the above Chinese collections as *Scutellinia setosa* (Nees) Kuntze, she noticed that spore walls are nearly smooth but with visible minute warts and sinuate crests on surface. Careful comparison of *Scutellinia setosa* (Schumacher, 1990) and the Xishuangbanna collection reveals that spore markings of the latter are obvious in SEM (Zhuang, 1994) and spores are not smooth-walled under light microscope. One specimen of *Scutellinia setosa* from Canada (HMAS 8932) was examined and compared but spore markings were not found. Since spore ornamentation is critical in taxonomy of the genus *Scutellinia* (Cooke) Lambotte, we treat the Chinese fungus as a new species.

Scutellinia subhirtella Svrcek, Ceska Mykol. 25: 85, 1971.

On wet wood. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 61438.

*** Scutellinia superba** (Velen.) Le Gal, Bull. Soc. Mycol. Fr. 80: 123, 1964. 短毛盾盘菌

On rotten bark. Collected in April.

Simao: HMAS 24106.

Hairs of the fungus are ventricose, rooting, with 1-3 rootlets, short, and 170-250 x 15-26 μm. Ascospores are ovoid to ellipsoid, nonguttulate, 19.5-22.5 x 12.0-15.5 μm, with warts and irregular ridges which are 1.0-1.5 μm wide and up to 0.5 μm high.

Scutellinia vitreola Kullm., Scrip. Mycol. Tartu 10: 92, 1982.

On wet wood. Collected in October.

Limestone Hill: HMAS 72123.

*** Stictis stellata** Wallr., Fl. Crypt. Germ. 2: 144, 1833. 星状点盘菌

On herbaceous stem. Collected in October.

Limestone Hill: HMAS 72161.

Sherwood (1977) provided detailed description of the fungus. It is a tropical species. Asci of the Chinese material are 9-12 μm wide and with cap 2.5-3.5 μm thick; ascospores are filiform, multiseptate, 1.8-2.8 μm wide, and ca 125 μm long; and paraphyses are straight to rarely branched at tip and 1 μm wide. This is the first time that the fungus is found in the mainland of China.

Torrendiella sp. (see Mycotaxon 40: 50, 1991.)

On leaf. Collected in October.

Road from Mengyang to Xishuangbanna Botanic Garden: HMAS 69562.

Trichoglossum cheliense F. L. Tai, Lloydia 7: 153, 1944.
On the ground. Collected in August.
Cheli: HMAS 1316, 2885, 4065, 4066.

Trichoglossum durandii Teng, Contr. Biol. Lab. Sci. Soc. 8: 52, 1932.
On the ground. Collected in August.
Cheli: HMAS 1313, 1321, 2883, 4050, 4074, 50420.

Trichoglossum hirsutum (Pers, : Fr.) Boud., Bull. Soc. Mycol. France 1: 110, 1885.
On the ground. Collected in August.
Cheli: HMAS 4059.

Trichoglossum octopartitum Mains, Ann. J. Bot. 27: 325, 1940.
On the ground. Collected in August.
Cheli: HMAS 4055.

Trichoglossum persoonii F. L. Tai, Lloydia 7: 154, 1944.
On the ground. Collected in August.
Cheli: HMAS 1314, 4060, 4067, 4068,4069, 4070, 4071, 4075.

Trichoglossum rasum Pat., Bull. Soc. Mycol. France 25: 132, 1909.
On the ground. Collected in August.
Cheli: HMAS 4056, 4058.

Trichoglossum sinicum F. L. Tai, Lloydia 7: 156, 1944.
On the ground. Collected in August.
Cheli: HMAS 1315.

Trichoglossum variabile (E. J. Durand) Nannf., Ark. Bot. 30A: 64, 1942.
On the ground. Collected in August.
Cheli: HMAS 4073.

Trichoglossum velutipes (Peck) E. J. Durand, Ann. Mycol. 6: 434, 1908.
On the ground. Collected in August.
Cheli: HMAS 4061, 4063.

Trichoglossum walteri (Berk.) E. J. Durand, Ann. Mycol. 6: 440, 1908.
On the ground. Collected in August.
Cheli: HMAS 4244.

Trichophaea abundans (P. Karst.) Boud., Hist. Class. Discom. Eur. p. 61, 1907.
On burnt palm material. Collected in October.
Xishuangbanna Botanic Garden: HMAS 57705.

Unguicularіopsis hysterigena (Berk. & Broome) Korf, Phytologia 21: 207, 1971.
On hymenium of *Rhytidhysteron rufulum*. Collected in October.
Limestone Hill: HMAS 57708.

Wolfina oblongispora (J. Z. Cao) W. Y. Zhuang & Z. Wang, Mycotaxon (in press).
On rotten wood. Collected in August.
Pu'er: HKAS 23300.

Wynnea gigantea Berk. & M. A. Curtis in Berk., J. Linn. Soc. Bot. 9: 424, 1867.
On the ground. Collected in May.
Xichou: HMAS 25221.

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中国热带盘菌初探之二
云南盘菌

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摘要：本文报道云南省热带地区盘菌 43 属 81 种和 1 个变型，其中版纳小孢盘菌 *Acervus xishuangbannicus* 、 云南八孢盘菌 *Octospora yunnanica* 和华刚毛盾盘菌 *Scutellinia sinosetosa* 为新种，鹿缘刺盘菌 *Cheilymenia elaphorum* 为新组合，盖尔粒毛盘菌 *Lachnum legalii* 为新名称。我国新记录 13 种分别为下列各属成员，即小孢盘菌属 *Acervus* 、耳盘菌属 *Aurophora* 、缘刺盘菌属 *Cheilymenia* 、粪裸盘菌属 *Coprotus* 、粒毛盘菌属 *Lachnum* 、厚盘菌属 *Pachyella* 、无柄盘菌属 *Pezicula* 、暗柔膜菌属 *Phaeohelotium* 、歪盘菌属 *Phillipsia* 和盾盘菌属 *Scutellinia* 。

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DISCOMYCETES OF TROPICAL CHINA. III HYALOSCYPHACEOUS FUNGI FROM TROPICAL GUANGXI *

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ABSTRACT Hyaloscyphaceous discomycetes from the tropical Guangxi, China have been studied. Among them, 24 species belonging to 7 genera were recognized. *Albotricha guangxiensis*, *Lachnum subpygmaeum*, *Lasiobelonium guangxiense*, *Parachnopeziza guangxiensis*, and *Parachnopeziza sinensis* are described as new species and *Albotricha* cf. *albotestacea*, *Arachnopeziza aurata*, *Lachnum* cf. *apalum* var. *beatonii*, *Lachnum blechnophilum*, *Lachnum willisii*, *Lachnum* taxonomic sp. #1, *Lachnum* taxonomic sp. #2, and *Proliferodiscus inspersus* var. *inspersus* are recorded for the first time from China.

In the past century, hyaloscyphaceous discomycetes were very occasionally reported from Guangxi Province, China. Till now, only three species, *Lachnum abnorme* (Mont.) J. H. Haines & Dumont, *Lachnum brasiliense* (Mont.) J. H. Haines & Dumont, and *Lachnum indicum* (Cash) J. H. Haines & Dumont, were known (Teng, 1963, 1996; Haines & Dumont, 1984). To explore the species diversity of higher fungi in tropical China, excursions were organized in Guangxi from the middle of December, 1997 to middle of January, 1998 by the Systematic Mycology and Lichenology Laboratory, Chinese Academy of Sciences. The forests of different regions were investigated, which are located to the north (Damingshan, Wuming), south (Shiwandashan Mountains, Shangsi including Dalongshan, Hongqi Forestry Station, Pinglongshan), and west (Defu Nature Reserve and Nonghua Nature Reserve, Napo) of Nanning, the capital city of the province. The collecting sites are at altitudes of 200-1300 m. Although it was not the best season for fungus hunting, more than 100 specimens of the hyaloscyphaceous discomycetes were found. Twenty-four species belonging to *Albotricha* Raitv., *Arachnopeziza* Fuckel, *Dasyscyphella* Tranzschel,

* Supported by the National Natural Science Foundation of China (Approved No. 39730020).

Lachnum Retz., *Lasiobelonium* Ellis & Everh., *Parachnopeziza* Korf, and *Proliferodiscus* J. H. Haines & Dumont are recognized. *Albotricha guangxiensis*, *Lachnum subpygmaeum*, *Lasiobelonium guangxiense*, *Parachnopeziza guangxiensis*, and *Parachnopeziza sinensis* are described as new species. *Albotricha* cf. *albotestacea* (Desm.) Raitv., *Arachnopeziza aurata* Fuckel, *Lachnum* cf. *apalum* (Berk. & Broome) Nannf. var. *beatonii* Spooner, *Lachnum blechnophilum* Spooner, *Lachnum willisii* (Beaton) Spooner, *Lachnum* taxonomic sp. #1, *Lachnum* taxonomic sp. #2, and *Proliferodiscus inspersus* (Berk. & M. A. Curtis) J. H. Haines & Dumont var. *inspersus* are reported for the first time from China, which are marked, in this paper, with an asterisk (*). Chinese names are provided only for new species and new records of China. Colors of hymenium and of receptacle and size of apothecia are based on fresh material. Specimens studied are deposited in the Herbarium Mycologicum Instituti Microbiologici Academiae Sinicae (HMAS).

ALBOTRICHA Raitv. 白毛盘菌属

Albotricha Raitv. is a small genus (Raitviir, 1970) which was later synonymized with *Lachnum* (Hawksworth *et al.*, 1995). There were more than 10 species accepted in the world (Raitviir, 1970, 1973, 1981). Species of the genus have never been reported from China. During my study of collections from Guangxi, a new species and a new Chinese record were found and it is reasonable to pick up *Albotricha* again to make *Lachnum* a more uniform genus.

* **Albotricha** cf. **albotestacea** (Desm.) Raitv., Scrip Mycol. 1: 40, 1970.
（参照）白壳白毛盘菌

Specimens examined: on stem of a monocotyledon, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu, S.-l. Chen & W.-y. Zhuang 2338, 2 I 1998, HMAS 72559; on stem and leaf sheath of a large grass, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu, S.-l. Chen & W.-y. Zhuang 2340, 2 I 1998, HMAS 72560.

The apothecia of our collections are cream-colored, 0.3-2.0 mm in diam, and with a short stalk. They have characteristic hairs which are hyaline, septate, smooth to faintly punctate on the surface, and narrow gradually to a drawn out, fine apex. Large, spherical, hyaline, resinous particles which may reach a diameter of 1.8 μm were found on the hair surface of HMAS 72559. Asci are mostly 50-56 x 4.5-5.0 μm. Two small polar guttules were found in the ascospores which are mostly 8 x 1.5-1.7 μm. Paraphyses are lanceolate, 2.5-4.0 μm wide and exceed the asci by 15-25 μm. The Chinese collections differs in ascospores ellipsoid with one end narrower instead of fusoid (Dennis, 1949).

Albotricha guangxiensis W. Y. Zhuang, **sp. nov.** (Fig. 1) 广西白毛盘菌

Ab speciebus aliis *Lachni* pilis acicularibus, directis, rigidis, glabro-tunicatis vel subtiliter asperulis; ascosporis subcylindricis, inferne angustis; paraphysibus anguste lanceolatis differt. Ab

Albotricha acutipila ascosporis 0-3-septatis, 43-54 x 1.8-2.2 μm; ascis grandibus, 72-84 x 8-9 μm differt.

Apothecia discoid, short-stipitate, 0.4-0.9 mm in diam; hymenium pale to light yellow, receptacle cream to light yellow, surface hairy; hairs needle-like, cylindrical in the middle, narrower gradually to the tip, slightly wider at the very base, septate, up to 40-80(-120) x 1.5-2.0 μm, walls nearly smooth to minutely roughened, hyaline, glassy, thin and rigid; ectal excipulum of textura angularis to textura prismatica, 13-26 μm thick, cells 4-9 μm in diam or 7-15 x 4-9 μm, walls hyaline, more or less glassy, smooth and thin; medullary excipulum of textura intricata, 30-100 μm thick, hyphae hyaline, mostly 1-2 μm wide; hymenium 80-85 μm thick; asci 8-spored, clavate to broadly clavate, J+ in Melzer's reagent, 72-84 x 8-9 μm; ascospores subcylindrical with the basal end slightly narrower, hyaline, 0-3-septate, multiguttulate, 43-54 x 1.8-2.2 μm; paraphyses narrowly lanceolate to subcylindrical with a pointed apex, 2-3 μm wide, exceeding the asci by 15-19 μm.

Holotype: on stem of monocotyledon, Damingshan, Wuming, Guangxi, China, alt. 1200 m, W. Y. Zhuang 1815, 19 XII 1997, HMAS 72603.

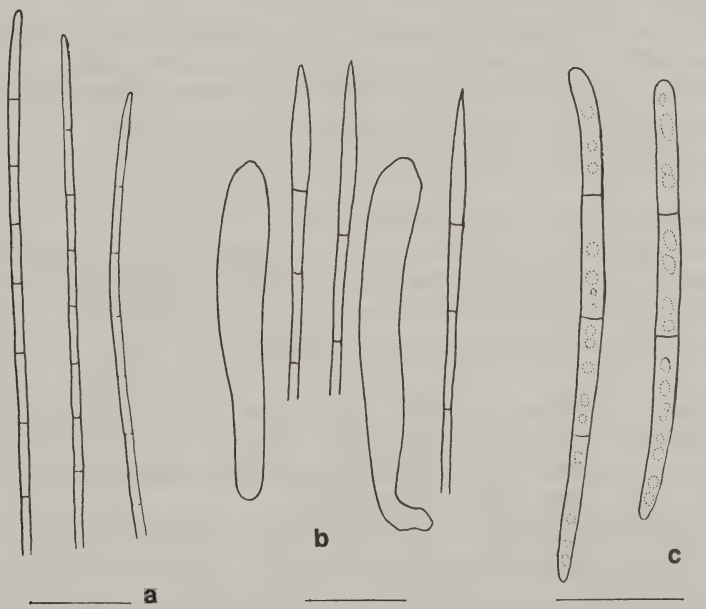


Fig. 1 *Albotricha guangxiensis*: **a**. Hairs; **b**. Asci and paraphysis apices; **c**. Ascospores; **a**, **b** scale = 20 μm, **c** scale = 10 μm. From holotype.

Paratype: on stem of monocotyledon, Damingshan, Wuming, Guangxi, China, alt. 1300 m, W. Y. Zhuang & S.-l. Chen 1880, 21 XII 1997, HMAS 72604.

This fungus is distinguished from species of *Lachnum* in the combination of the following features: hairs needle-like, straight, and rigid, with nearly smooth to minutely roughened walls; ascospores subcylindrical with one end narrow, and paraphyses narrowly lanceolate with a pointed apex. Shape and size of ascospores are within the range of those in *Lachnum abnorme*, but hair morphology is entirely different.

The fungus shows characteristics of both *Lachnum* and the long-haired species in *Phialina* Hoehn. (Huhtinen, 1989). A suitable genus was not found when Svrcek's key to genera of the Hyaloscyphaceae was consulted (Svrcek, 1987). It seems that two Chinese collections share more features with *Lachnum* than with *Phialina* although they do not fit *Lachnum* well.

Albotricha Raitv. (1970), later synonymized with *Lachnum* (Hawksworth *et al.*, 1995), was established to accommodate species possessing needle-like, hyaline to pale colored, smooth-walled, septate hairs; fusoid, ellipsoid or cylindrical, uniseptate to rarely multiseptate ascospores; and lanceolate paraphyses. HMAS 72603 and 72604 fit every features of *Albotricha*. In my opinion, these features are distinct enough at the generic level. Excluding taxa of *Albotricha* from *Lachnum* will make the large genus *Lachnum* more uniform. Raitviir's generic concept is thus accepted and the two Guangxi collections turn out to be a new taxon in *Albotricha*. Hairs of *Albotricha guangxiensis* are similar to those of *Albotricha acutipila* (P. Karst.) Raitv. (Dennis, 1949), but ascospores are quite different, asci much larger, and hairs very narrow and cylindrical in the middle.

ARACHNOPEZIZA Fuckel 蛛盘菌属

Arachnopeziza is a small genus (Korf, 1951; Huhtinen, 1987). Two species were previously found in Sichuan, China (Korf & Zhuang, 1985) and *Arachnopeziza aurata* from Shiwandashan Mountains, Guangxi is now added. Ascospore morphology is very important in taxonomy of the genus.

* **Arachnopeziza aurata** Fuckel, Jahrb. Nass. Vereins Naturk. 23-24: 304, 1870.
金蛛盘菌

Specimen examined: on rotten wood, Hongqi Forestry Station, Shangsi, alt. 400 m, W.-y. Zhuang 1984, 29 XII 1997, HMAS 72654.

Presence of a subiculum is an important character of this genus. HMAS 72654 fits well the description of *Arachnopeziza aurata* given by Korf (1951). The asci of the Chinese collection are 85-107 x 10.5-12.0 μm and ascospores are 42-52 x 2.0-2.7(-3.0) μm.

DASYSCYPHELLA Tranzschel 小毛钉菌属

Eight species of *Dasyscyphella* have been found in the world (Raitviir, 1977; Galán & Moreno, 1984). One species is known from China. It was previously

recorded as *Dasyscypha nivea* (Hedw.) Sacc. from Sichuan and Yunnan provinces (Tai, 1979). *Dasyscyphella* is the correct genus for the fungus.

Dasyscyphella nivea (Hedw. : Fr.) Raitv., Scrip. Mycol. 1: 72, 1970.
雪白小毛钉菌

Specimen examined: on rotten wood, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang & W.-p. Wu 1842, 19 XII 1997, HMAS 72551.

The fungus is characterized by the hyaline hairs which are straight, rigid, very slightly enlarged at the apex, smooth-walled on surface of the apical cell and granulate below. The apothecia are 0.7-1.0 mm in diam and pure white; asci J+ in Melzer's reagent, mostly 48-52 x 5.0-5.5 μm; and ascospores (4-)6-7 x 1.2-2.0 μm. The Chinese material differs from the Australasian ones (Spooner, 1987) in shorter asci and ascospores and in paraphyses not narrowly lanceolate and exceeding the asci by 10-12 μm but subcylindrical and not obviously exceeding asci.

LACHNUM Ratz. 粒毛盘菌属

Lachnum is a fairly large genus which contains about 150 species in the world (Hawksworth *et al.*, 1995). In the literature, Chinese species of the genus may also be found under *Dasyscyphus* and *Erinellina* in addition to *Lachnum*. Around 40 species are probably known in China (Teng, 1963, 1996; Liou & Chen, 1977; Tai, 1979; Korf & Zhuang, 1985; Zhuang, 1989; Wu *et al.*, 1996; Zhuang & Wang, 1998a, 1998b, 1999). Sixteen taxa have been collected in tropical Guangxi.

Lachnum abnorme (Mont.) J. H. Haines & Dumont, Mycotaxon 19: 10, 1984.

Specimens examined: on twig, Damingshan, Wuming, alt. 1200 m, W.-y. Zhuang & W.-p. Wu 1799 , 18 XII 1997, HMAS 72552; on small rotten twig, Damingshan, Wuming, alt. 1200 m, W.-y. Zhuang 1809, 18 XII 1997, HMAS 72553; on rotten bark, Damingshan, Wuming, alt. 1200 m, W.-y. Zhuang & W.-p. Wu 1921, 20 XII 1997, HMAS 72554; on stem of a monocotyledon, Damingshan, Wuming, alt. 700 m, S.-l. Chen & W.-y. Zhuang 1929, HMAS 72555; on rotten twig, Hongqi Forestry Station, Shangsi, alt. 400 m, W.-y. Zhuang 1995, 29 XII 1997, HMAS 72556; on stem of a monocotyledon, Pinglongshan, Shangsi, alt. 500 m, W.-y. Zhuang & X.-q. Zhang 2364, 2 I 1998, HMAS 72557; on rotten twig, Pinglongshan, Shangsi, alt. 500 m, S.-l. Chen & W.-y. Zhuang 2374, 2 I 1998, HMAS 72558.

* **Lachnum** cf. **apalum** (Berk. & Broome) Nannf. var. **beatonii** Spooner, Bibl. Mycol. 116: 486, 1987. （参照）软粒毛盘菌毕氏变种

Specimen examined: on leaf blade of an unidentified plant (?tree), Damingshan, Wuming, alt. 1200 m, W.-y. Zhuang 1905, 22 XII 1997, HMAS 72561.

The Chinese fungus has small apothecia which are 0.2-0.5 mm in diam, cream to pale yellow hymenium and whitish receptacle surface. It differs from the Australasian collections described by Spooner (1987) in ascospores narrow, 45-50 x 1.0-1.2 μm, and with 0-1 septum (?young) instead of 1-3-septate; paraphyses narrowly lanceolate,

2.2-3.0 um wide, exceeding the asci by 5 μm instead of 3-5(-6) μm wide and exceeding the asci by up to 25 μm; asci narrower, 55-72 x 5.0-5.5 μm; and a entirely different host. It might represent an undescribed taxon but material is too poor to be a type and further study is needed.

Lachnum apalum (Berk. & Broome) Nannf. var. *apalum* was reported previously from Taiwan Province (Liou & Chen, 1977).

Lachnum attenuatum J. H. Haines & Dumont, Mycotaxon 19: 35, 1984.
渐狭粒毛盘菌

Specimen examined: on small twig, Damingshan, Wuming, alt. 1200 m, W.-y. Zhuang & W.-p. Wu 1914, 22 XII 1997, HMAS 72562.

This species is characterized by its narrowly clavate ascospores. HMAS 72562 may not be fully mature since ascospores have 0-3 septa, smaller (40-45 x 2.5-3.0 μm) than what was described by Haines & Dumont (1984). The previous Chinese record was based on one collection from Taiwan Province (Wu *et al.*, 1996).

* **Lachnum blechnophilum** Spooner, Bibl. Mycol. 116: 464, 1987.
乌毛蕨粒毛盘菌

Specimens examined: on fern, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang & W.-p. Wu 1833, 19 XII 1997, HMAS 72563; on fern, Hongqi Forestry Station, Shangsi, alt. 450 m, W.-y. Zhuang & W.-p. Wu 1969, 28 XII 1997, HMAS 72564; on fern, Hongqi Forestry Station, Shangsi, alt. 450 m, W.-p. Wu & W.-y. Zhuang 1974, 28 XII 1997, HMAS 72565; on rotten leaf of fern, Hongqi Forestry Station, Shangsi, alt. 400 m, W.-p. Wu & W.-y. Zhuang 1988, 29 XII 1997, HMAS 72566; on root of fern, Dalongshan, Shangsi, alt 280 m, W.-p. Wu & W.-y. Zhuang 2334, 1 I 1998, HMAS 72567; on fern, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu, S.-l. Chen & W.-y. Zhuang 2337, 2 I 1998, HMAS 72568; on fern, Pinglongshan, Shangsi, alt. 500 m, S.-l. Chen & W.-y. Zhuang 2355, 2 I 1998, HMAS 72569; on fern, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu, S.-l. Chen & W.-y. Zhuang 2356, 2357, 2 I 1998, HMAS 72570, 72571; on fern, Pinglongshan, Shangsi, alt. 500 m, W.-y. Zhuang 2362, 2 I 1998, HMAS 72572; on fern, Pinglongshan, Shangsi, alt. 500 m, W.-y. Zhuang & S.-l. Chen 2373, 2 I 1998, HMAS 72573; on fern, Defu, Napo, alt. 1100 m, X.-q. Zhang & W.-y. Zhuang 2377, 10 I 1998, HMAS 72574; on fern, Defu, Napo, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2383, 2392, 10 I 1998, HMAS 72575, 72576.

This is a very common fungus in the places surveyed although these are the first records from China. It differs from the Australasian material (Spooner, 1987) in ascospores subfusoid with narrower ends instead of cylindrical or cylindrical-clavate, always with a dark-stained area in the center of spores when mounted in cotton blue solution. Presence of a row of guttules in ascospores is a distinct feature of this species.

Lachnum brasiliense (Mont.) J. H. Haines & Dumont, Mycotaxon 19: 23, 1984.

Specimens examined: on bark of a branch, Damingshan, Wuming, alt. 1200 m,

W.-y. Zhuang 1806, 18 XII 1997, HMAS 72577; on small twig, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1826, 19 XII 1997, HMAS 72578; on rotten twig, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1853, 1855, 1856, 1857, 19 XII 1997, HMAS 72579, 72580, 72581, 72582; on rotten twig, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1866, 20 XII 1997, HMAS 72583; on bark, Damingshan, Wuming, alt. 900 m, W.-p. Wu & W.-y. Zhuang 1877, 21 XII 1997, HMAS 72584; on twigs, Damingshan, Wuming, alt. 1200 m, W.-p. Wu & W.-y. Zhuang 1892, 1900, 1917, 22 XII 1997, HMAS 73428, 72586, 72587; on rotten bark, Hongqi Forestry Station, Shangsi, alt. 400 m, W.-y. Zhuang 1989, 1993, 29 XII 1997, HMAS 72588, 72589; on bark, Hongqi Forestry Station, Shangsi, alt. 400 m, S.-l. Chen & W.-y. Zhuang 2304, 29 XII 1997, HMAS 72590; on rotten twig, Defu, Napo, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2389, 10 I 1998, HMAS 72591.

Lachnum flavidulum (Rehm) J. H. Haines, Mycotaxon 22: 501, 1985.

Specimens examined: on fern, Hongqi Forestry Station, Shangsi, alt. 300 m, W.-p. Wu & W.-y. Zhuang 1953, 27 XII 1997, HMAS 72592; on fern, Hongqi Forestry Station, Shangsi, alt. 300 m, W.-y. Zhuang & W.-p. Wu 1957, 27 XII 1997, HMAS 72593; on fern Hongqi Forestry Station, Shangsi, alt. 450 m, W.-y. Zhuang & W.-p. Wu 1973, 28 XII 1997, HMAS 72594; on fern Hongqi Forestry Station, Shangsi, alt. 400 m, S.-l. Chen & W.-y. Zhuang 1983, 1996, 29 XII 1997, HMAS 72595, 72596; on fern, Dalongshan, Shangsi, alt. 280 m, S.-l. Chen & W.-y. Zhuang 2330, 1 I 1998, HMAS 72597; on fern, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu & W.-y. Zhuang 2336, 2 I 1998, HMAS 72598; on fern, Defu, Napo, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2390, 10 I 1998, HMAS 72599.

HMAS 72599 has apothecia 4-20 growing in a fascicle and ascospores narrow, 7.0-9.5 x 1.2-1.7 µm.

Lachnum indicum (Cash) J. H. Haines & Dumont, Mycotaxon 19: 16, 1984.

Specimens examined: on rotten bark, Damingshan, Wuming, alt. 1200 m, W.-p. Wu & W.-y. Zhuang 1895, 22 XII 1997, HMAS 72601; on rotten bark, Defu, Napo, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2407, 10 I 1998, HMAS 72602.

Lachnum lushanense W. Y. Zhuang & Z. Wang, Mycotaxon 66: 429, 1998.

Specimen examined: on stem of a monocotyledon, Pinglongshan, Shangsi, alt. 500 m, W.-p Wu, S.-l. Chen & W.-y. Zhuang 2352, 2 I 1998, HMAS 72605.

This species characterized by its red hairs and narrowly fusoid ascospores does not fit any red species of *Lachnum* reported by Cantrell & Haines (1997) from the tropics. It is identical with the type specimen of *Lachnum lushanense* collected originally from Lushan, Jiangxi Province (Zhuang & Wang, 1998a), a subtropical area. HMAS 72605 is the second collection of this species from China. It seems uncommon in the areas surveyed but might have a wider distribution in the southern China than we know.

Lachnum sclerotii (A. L. Sm.) J. H. Haines & Dumont, Mycotaxon 19: 17, 1984.

Specimens examined: on rotten bark, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1846, 19 XII 1997, HMAS 72608; on very rotten wood, Damingshan, Wuming, alt. 1200 m, W.-p. Wu & W.-y. Zhuang 1897, 22 XII 1997, HMAS 72609; on rotten twigs with bark, Hongqi Forestry Station, alt. 400 m, W.-p. Wu & W.-y. Zhuang 1981, 29 XII 1997, HMAS 72610.

Lachnum singerianum (Dennis) W. Y. Zhuang & Z. Wang, Mycotaxon 67: 27, 1998.

Specimens examined: on fern, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1849, 19 XII 1997, HMAS 72611; on fern, Hongqi Forestry Station, alt. 400 m, W.-y. Zhuang & W.-p. Wu 1987, 29 XII 1997, HMAS 72612.

Lachnum singerianum was recently recorded from Hainan Island (Zhuang & Wang, 1998b) where one collection was found. It is not as common there as it is in tropical America (Haines, 1980).

Lachnum subpygmaeum W. Y. Zhuang, **sp. nov.** (Fig. 2) 亚根粒毛盘菌

Ab *Lachno pygmaeo* ascosporis 2(-4)-guttulatis, 11.0-13.1 x 2.3-2.8 μm; ascis latis, 65-81 x 6.5-7.0 μm; paraphysibus subcylindricis, 1.8-2.0 μm lato; pilis longis, 50-65 x 2.5-3.0 μm differt.

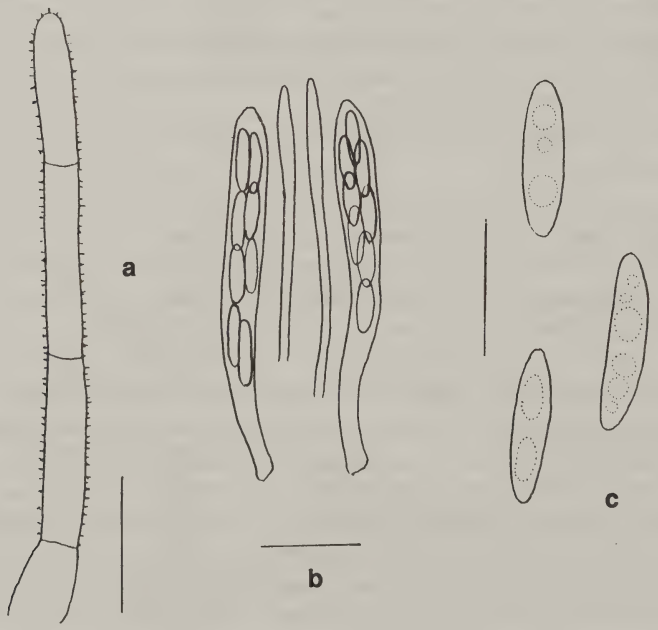


Fig. 2 *Lachnum subpygmaeum*: **a**. A hair; **b**. Asci and paraphysis apices; **c**. Ascospores; **a**, **c** scale = 10 μm, **b** scale = 20 μm. From holotype.

Apothecia discoid, short-stipitate, 1-2 mm in diam; hymenium cream, receptacle white; hairs cylindrical, granulate, thin-walled, hyaline, with 2-3 septa, mostly 38-90 x 2.5-3.0 μm; ectal excipulum two-layered, outer layer of textura prismatica, 13-38 μm thick, inner layer of textura porrecta, 8-20 μm thick, ectal cells 10-20 x 5.7.5 μm, walls hyaline, thin; medullary excipulum of textura intricata, 20-75 μm thick, hyphae hyaline, 1.5-2.5 μm wide; hymenium ca 84 μm thick; asci 8-spored, J+ in Melzer's reagent, 65-81 x 6.5-7.0 μm; ascospores elongate-ellipsoid with rounded ends, irregularly biseriate to irregularly uniseriate, hyaline, with 2(-4) large guttules, 10.0-13.1 x 2.3-2.8 μm; paraphyses narrowly lanceolate, 1.8-2.0 μm wide, exceeding the asci by 4-8 μm.

Holotype: on rotten ?vines and small twig, Damingshan, Wuming, Guangxi, China, alt. 1100 m, W.-y. Zhuang 1832, 19 XII 1997, HMAS 72607.

Lachnum subpygmaeum differs from *Lachnum pygmaeum* (Fr.) Bres. (White, 1942; Dennis, 1949; Spooner, 1987) in ascospores with 2(-4) large guttules, 10.0-13.1 x 2.3-2.8 μm instead of 7-10 x 1.6-2.4 μm; asci wider, 65-81 x 6.5-7.0 μm; paraphyses narrowly lanceolate, 1.8-2.0 μm wide, exceeding the asci by only 4-8 μm instead of lanceolate, (2.0-) 3.0-4.5 μm wide, exceeding the asci by 10-20 μm; and hairs longer.

Lachnum virgineum (Batsch) P. Karst., Mycol. Fenn. 1: 169, 1871.

Specimens examined: on herbaceous stem, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1825, 19 XII 1997, HMAS 72613; on herbaceous stem, Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1843, 19 XII 1997, HMAS 72614; on graminaceous stem, Pinglongshan, Shangsi, alt. 500 m, X.-q. Zhang & W.-y. Zhuang 2360, 2 I 1998, HMAS 72615; on leaf spots of *Rubus* sp., Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu & W.-y. Zhuang 2368, 2 I 1998, HMAS 72616; on fern, Pinglongshan, Shangsi, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2385, 10 I 1998, HMAS 72617; on leaf of monocotyledon, Defu, Napo, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2398, 10 I 1998, HMAS 72618.

Lachnum cf. **virgineum** (Batsch) P. Karst.

Specimens examined: on small rotten twig, Damingshan, Wuming, alt. 1200 m, W.-y. Zhuang 1919, 22 XII 1997, HMAS 72619; on small twig, Hongqi Forestry Station, alt. 400 m, S.-l. Chen & W.-y. Zhuang 1992, 29 XII 1997, HMAS 72620; on fern, Dalongshan, Shangsi, alt. 280 m, W.-y. Zhuang 2325, 1 I 1998, HMAS 72621; on small twig, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu, S.-l. Chen & W.-y. Zhuang 2354, 2 I 1998, HMAS 72622; on rotten twig, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu, S.-l. Chen & W.-y. Zhuang 2361, 2 I 1998, HMAS 72623; on rotten twig, Defu, Napo, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2381, 10 I 1998, HMAS 72624; on herbaceous stem, Defu, Napo, alt. 1100 m, S.-l. Chen & W.-y. Zhuang 2391, 2402, 10 I 1998, HMAS 72625, 72626.

The above specimens examined are of very uniform morphology, which are different from typical *Lachnum virgineum* in hairs shorter, 50-76 μm long, with a swollen apex, 4.5-6.0 μm at the widest; ascospores symmetrically ellipsoid, lack of

obvious guttules. Although Spooner (1987) indicated that some collections of *Lachnum virgineum* show swollen hair apices, these collections are easily separated from the typical material and temporarily treated as *Lachnum* cf. *virgineum*.

*** Lachnum willisii** (Beaton) Spooner, Bibl. Mycol. 116: 510, 1987.
威氏粒毛盘菌

Specimen examined: on leaves of *Cinnamomum* sp., Damingshan, Wuming, alt. 1100 m, W.-y. Zhuang 1848, 19 XII 1997, HMAS 72627.

The Guangxi collection is different from the Australasian material (Spooner, 1987) in ascospores somewhat small, 6-7 x 1-1.3 μm; hairs 40-100 x 4 μm, with fewer granules on surface and more septa; and a different host plant.

*** Lachnum** taxonomic **sp. #1** (Fig. 3) 粒毛盘菌属未定名种 #1

Apothecia discoid, stipitate, up to 0.5 mm in diam; hymenium light yellow, receptacle concolorous, with hairs on surface; hairs cylindrical, granulate, pale yellow, thin-walled, 1(-2)-septate, 18-48(-57) x 3-3.5 μm; ectal excipulum of textura prismatica, 18-32 μm thick, cells short, hyaline, 7-17 x 3-7 μm; medullary excipulum of textura intricata, 25-90 μm thick, hyphae hyaline, 1.5-3.0 μm wide; hymenium 62-66 μm thick; asci 8-spored, subcylindrical, J+ in Melzer's reagent, 46-57 x 5.0-5.6μm;

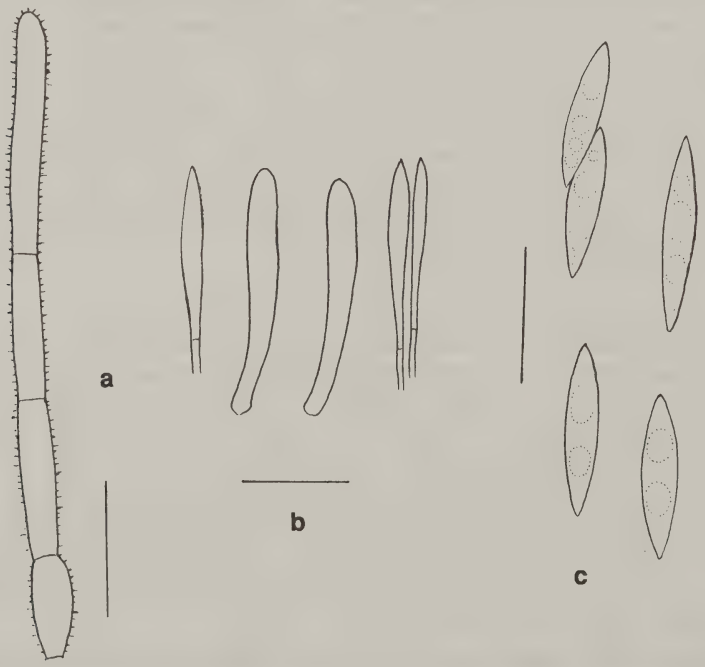


Fig. 3 *Lachnum* taxonomic sp. #1: **a**. A hair; **b**. Asci and paraphysis apices, scale = 20 μm; **c**. Ascospores; **a**, **c** scale = 10 μm. From HMAS 72600.

ascospores fusoid with pointed ends, irregularly uniseriate to irregularly biseriate, hyaline, one-celled, with 2-3(-4) obvious guttules, 10-13(-17) x 2.0-2.5 μm; paraphyses lanceolate, septate only at base, 2.5-4.0 μm wide at the widest, exceeding the asci by 3-8 μm.

Specimen examined: on an unidentified fern, Damingshan, Wuming, Guangxi, China, alt. 1100 m, W. Y. Zhuang 1850, 19 XII 1997, HMAS 72600.

This fungus is similar to *Lachnum pinnicolum* Spooner (1987) from Australia in small fruitbodies, shape of ascospores, of asci, and of paraphyses, and the habitat. It differs from the latter in much smaller asci (46-57 x 5-5.6 μm *vs.* 68-82 x 9.5-11 μm) and ascospores [10-13(-17) x 2.0-2.5 μm *vs.* (19-)20-23 x 3.5-4.0 μm] which are non-septate instead of 3-septate, and shorter hairs [21-57 x 3 μm *vs.* 60-90(-100) x 3-4 μm]. HMAS 72600 is certainly new in the genus *Lachnum* but the material is too poor to be a type.

*** Lachnum** taxonomic **sp. #2** (Fig. 4) 粒毛盘菌属未定名种 #2

Apothecia discoid, short-stipitate, 0.6-1.2 mm in diam, hymenium light cream, receptacle white; ectal excipulum of textura prismatica, medullary excipulum of textura intricata; asci 8-spored, subcylindrical, J+ in Melzer's reagent, arising from

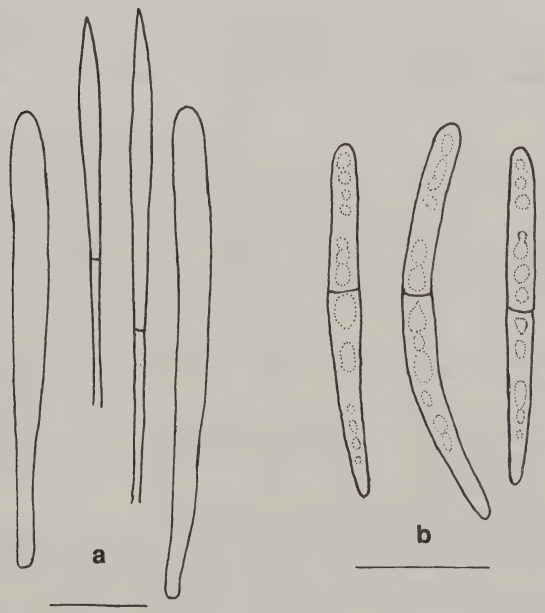


Fig. 4 *Lachnum* taxonomic sp. #2: **a**. Asci and paraphysis apices, scale = 20 μm; **b**. Ascospores; scale = 10 μm. From HMAS 72606.

repeating croziers, 81-105 x 5.0-6.5 μm; ascospores narrowly clavate, with one end rounded and one narrower, slightly curved, hyaline, uniseptate, 25-31 x 1.5-2.3 μm; paraphyses lanceolate, with a pointed apex, 3.0-4.5 μm at the widest, exceeding the asci by 13-18 μm.

Specimen examined: on leaf sheath of a small bamboo, Damingshan, Wuming, alt. 1200 m, W.-p. Wu & W.-y. Zhuang 1904, 22 XII 1997, HMAS 72606.

This fungus is close to *Lachnum nothofagi* (Dennis) Spooner (1987) reported from Australia and New Zealand. It differs from the latter in shape of ascospores (narrowly clavate with one end rounded instead of narrowly fusoid), shape of paraphyses (lanceolate instead of cylindrical or sometimes narrowly lanceolate), and the substrate (on leaf sheath of bamboo instead of dead bark of *Nothofagus*). The Chinese fungus represents an undescribed species but material is too poor to be a type. It is treated here as *Lachnum* taxonomic sp. #2.

LASIOBELONIUM Ellis & Everh. 针毛盘菌属

Three species have been accepted in the genus. Spooner (1987) provided a good generic concept and a detailed study of the Australasian taxa. Our recent collection from Guangxi represents an as yet undescribed species. The genus is probably larger than what we currently know.

Lasiobelonium guangxiense W. Y. Zhuang, **sp. nov.** (Fig. 5) 广西针毛盘菌

Ab *Lasiobelonio subflavido* ascis crassis, 98-107 x 13-17 μm; ascosporis brunneolis, 23-26 x 5.5-7.0 μm differt.

Apothecia discoid to cupulate, sessile, 0.6-0.9 mm in diam; hymenium grayish yellow, beige to dirty yellow, receptacle brownish, surface hairy; hairs slightly thick-walled, cylindrical, brown at base and gradually becoming subhyaline towards the apex, walls roughened below and smooth in the upper portion; ectal excipulum of textura angularis at flanks and textura prismatica at margin, 25-65 μm thick, cells mostly 5-8 μm in diam, walls brown; medullary excipulum of textura intricata, 18-90 μm thick, hyphae brown, 1.5-2.0 μm wide; hymenium ca 100 μm thick; asci 8-spored, broadly clavate, J+ in Melzer's reagent, 98-107 x 13-17 μm; ascospores ellipsoid to subfusoid, light brown, 3-septate, slightly constricted at septa, irregularly biseriate, 23-26 x 5.5-7.0 μm; paraphyses filiform, with a blunt apex, 1.5-2 μm wide.

Holotype: on twig, Damingshan, Wuming, Guangxi, China, alt. 1200 m, W. Y. Zhuang & W.-p. Wu 1915, 22 XII 1997, HMAS 72628.

In the genus *Lasiobelonium*, *L. guangxiense* is similar to *L. subflavidum* Ellis & Everh. (Spooner, 1987) in shape and septation of ascospores but differs from the latter in much broader asci [98-107 x 13-17 μm *vs.* (81-)85-100(-106) x (8-)9-12 μm] and in ascospores light brown and broader [23-26 x 5.5-7.0 μm *vs.* 15-21(-25) x 3.0-3.8 μm].

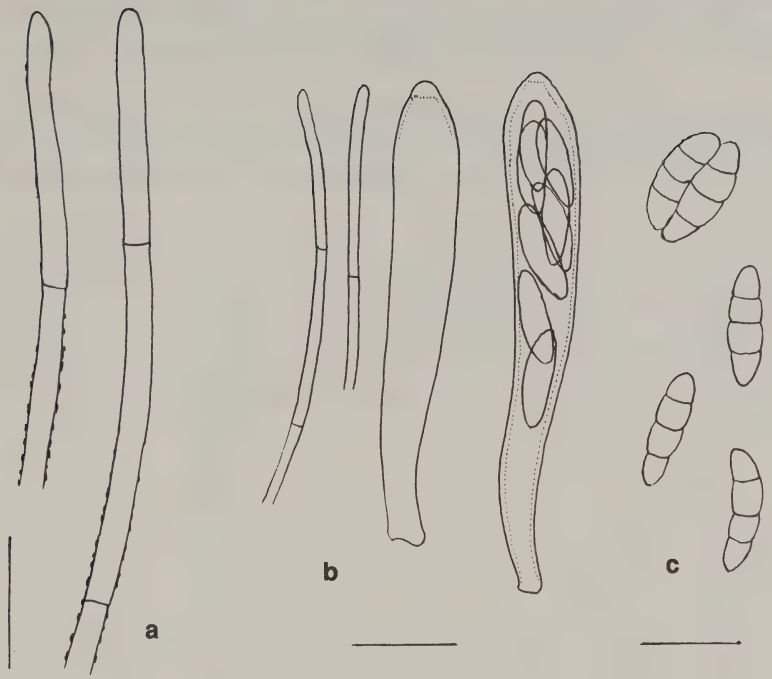


Fig. 5 *Lasiobelonium guangxiense*: **a**. Hairs, scale = 10 μm; **b**. Asci and paraphysis apices; **c**. Ascospores; **b, c** scale = 20 μm. From holotype.

PARACHNOPEZIZA Korf 近蛛盘菌属

Parachnopeziza, containing 2 species, remains unchanged since its establishment (Korf, 1978; Hawksworth *et al.*, 1995). Two new species are found in our collections from Guangxi.

Parachnopeziza guangxiensis W. Y. Zhuang & Korf, **sp. nov.** (Fig. 6)
广西近蛛盘菌

Ab speciebus aliis *Parachnopezizae* ascosporis anguste clavatis, 0-7-septatis, 30-35 x 2.7-3.0 μm differt.

Apothecia discoid, sessile, seated on a white subiculum, 0.2-0.4 mm in diam; hymenium yellow, receptacle white, surface hairy; hairs filiform, strongly coiled, hyaline, glassy, smooth-walled, with a fine lumen of cytoplasm, 2.0-2.5 μm wide; ectal excipulum of textura angularis at flanks and textura prismatica near margin, 6-50 um thick, cells mostly isodiametric at lower flanks, walls refractive, 4-10 μm in diam; medullary excipulum of textura intricata mixed with textura angularis, 10-30 μm thick,

hyphae hyaline, ca 1 μm wide; hymenium 110-120 μm thick; asci 8-spored, clavate, J+ in Melzer's reagent, 62-74 x 8.5-11 μm; ascospores elongated clavate, 0-7-septate, hyaline, 30-35 x 2.7-3.0 μm; paraphyses filiform, slightly deformed at apex, ca 1.5 μm wide.

Holotype: on heads of an unidentified graminaceous plant, Hongqi Forestry Station, Shiwandashan Mountains, Shangsi, Guangxi, China, alt. 400 m, W.-p. Wu, S.-l. Chen & W. Y. Zhuang 2302, 29 XII 1997, HMAS 73401; isotype CUP-CH 2537.

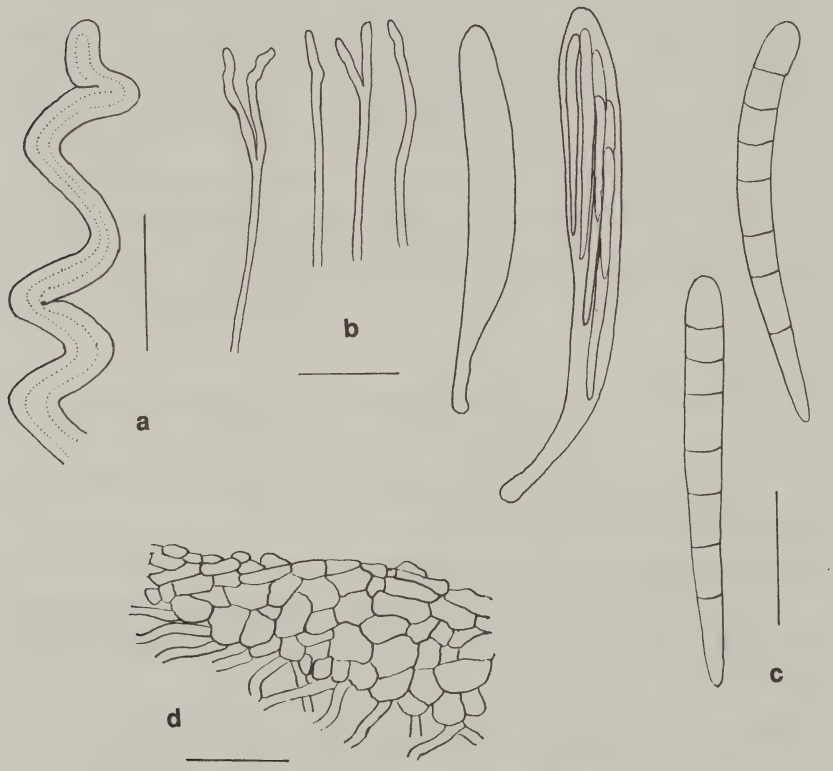


Fig. 6 *Parachnopeziza guangxiensis*: **a**. A hair; **b**. Paraphysis apices and asci; **c**. Ascospores; **d**. Ectal excipulum at flanks; **a**, **c** , scale = 10 μm ; **b**, **d** scale = 20 μm. From holotype.

Among the existing taxa of the genus (Hawksworth *et al*., 1995), this fungus is similar to *Parachnopeziza miniopsis* (Ellis) Korf (1978) in hair morphology but differs obviously in shape, size and septation of ascospores.

Parachnopeziza guangxiensis seems common in the Shiwandashan Mountains and encountered frequently during the field work there although a single collection was made, which is ample. It might be pathogenic to the host, a wild large

graminaceous plant. The infected heads or flower part of the host became blackened and dried. Host specificity and characteristics in culture are not known. Further study might show whether the fungus has any potential use in weed-control.

Parachnopeziza sinensis W. Y. Zhuang & Korf, **sp. nov.** (Fig. 7) 中国近蛛盘菌

Ab *Parachnopeziza miniopsis* differt apotheciis bambusicolis, albis, 0.2-0.6 mm diam; ascis longis, 107-165 x 10.5-12.5 μm; ascosporis 60-103 x 2-3 μm.

Apothecia on white subiculum, discoid, sessile, 0.2-0.6 mm in diam, hymenium pure white to pale cream, receptacle white; hairs coiled strongly, hyaline, septate, walls thick, smooth, and glassy, 1.5-2 μm wide; ectal excipulum of textura angularis, cells more or less isodiametric, 2-5 μm in diam or up to 5.5 x 3 μm, walls hyaline and glassy; medullary excipulum of textura intricata, thin, hyphae hyaline, thin-walled, ca 1 μm wide; asci 8-spored, clavate with a narrow tail, J+ in Melzer's reagent, 107-165

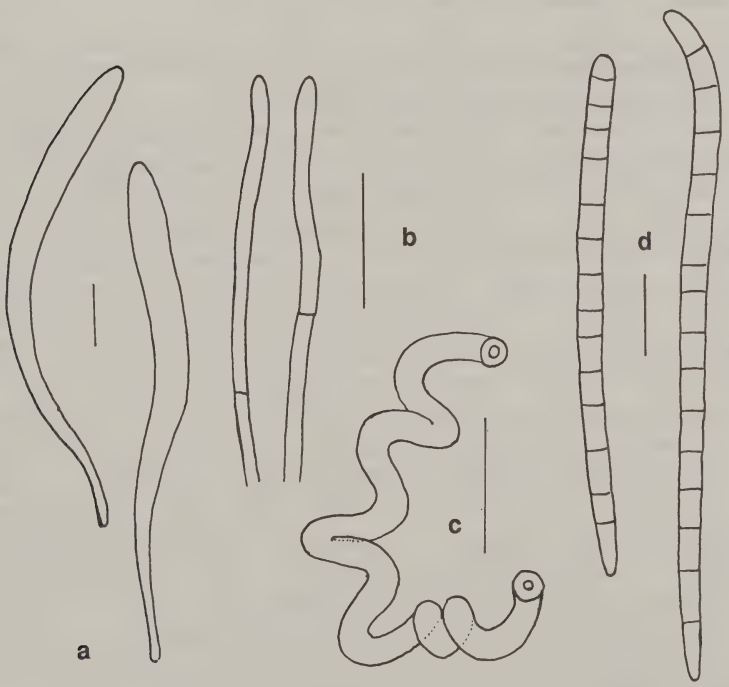


Fig. 7 *Parachnopeziza sinensis*: **a**. Two asci; **b**. Paraphysis apices; **c**. A fragment of hair; **d**. Ascospores; **a** scale = 20 μm ; **b**, **c**, **d** scale = 10 μm. **a**, **b**, **c** from HMAS 72629, **d** from HMAS 72630.

x 10.5-12.5 μm; ascospores cylindrical with lower end narrower, hyaline, up to 15-septate, multiguttulate, 60-103 x 2-3 μm; paraphyses filiform, 1.5-1.7 μm wide.

Holotype: on leaf sheath of bamboo, Pinglongshan, Shangsi, Guangxi, China, alt. 500 m, W.-y. Zhuang 2369, 2 I 1998, HMAS 72630; isotype CUP-CH 2538.

Paratype: on leaf sheath of a monocotyledon, Damingshan, Wuming, Guangxi, China, alt. 1200 m, W.-y. Zhuang & W.-p. Wu 1906, 11 XII 1997, HMAS 72629.

The genus *Parachnopeziza* was studied and illustrated in a detail by Korf (1978). The Guangxi collections are different from the North American *Parachnopeziza miniopsis* (Ellis) Korf in the pure white apothecia, longer asci with a fine tail, somewhat short ascospores [60-103 x 2-3 μm *vs.* (82-)84-99(-105) x 2.8-3.7 μm], and on leaf sheath of bamboo and of a graminaceous plant instead of on *Acer*.

PROLIFERODISCUS J. H. Haines & Dumont 层出盘菌属

Six taxa of the genus have been accepted in the world (Haines & Dumont, 1983; Spooner, 1987; Zhuang, 1989). So far, two varieties of the same species, *Proliferodiscus inspersus*, are known from China.

* **Proliferodiscus inspersus** (Berk. & M. A. Curtis) J. H. Haines & Dumont var. **inspersus** Mycologia 75: 538, 1983. 层出盘菌原变种

Specimens examined: on rotten twig, Damingshan, Wuming, alt. 1200 m, W.-y. Zhuang 1810, 18 XII 1997, HMAS 72631; on bark of a twig, Damingshan, Wuming, alt. 1200 m, W.-p. Wu & W.-y. Zhuang 1896, 1898, 1907, 22 XII 1997, HMAS 72585, 72632, 72633; on rotten bark, Damingshan, Wuming, alt. 700 m, W.-y. Zhuang 1925, 23 XII 1997, HMAS 72634; on a ?vine, Hongqi Forestry Station, alt. 300 m, W.-y. Zhuang 1943, 27 XII 1997, HMAS 72635; on wood, Hongqi Forestry Station, alt. 250 m, W.-y. Zhuang 1964, 27 XII 1997, HMAS 72636; on rotten twigs, Hongqi Forestry Station, alt. 450 m, W.-y. Zhuang & W.-p. Wu 1972, 28 XII 1997, HMAS 72637; on twigs, Hongqi Forestry Station, alt. 400 m, W.-p. Wu, W.-y. Zhuang & S.-l. Chen 1982, 29 XII 1997, HMAS 72638; on bark of pine, Hongqi Forestry Station, alt. 400 m, W.-y. Zhuang & S.-l. Chen 1990, 1991, 29 XII 1997, HMAS 72639, 72640; on twigs, Hongqi Forestry Station, alt. 400 m, W.-p. Wu & W.-y. Zhuang 2301, 2305, 29 XII 1997, HMAS 73427, 72641; on small twigs, Dalongshan, Shangsi, alt 280 m, W.-y. Zhuang & W.-p. Wu 2327, 1 I 1998, HMAS 72642; on twig, Dalongshan, Shangsi, alt 280 m, S.-l. Chen & W.-y. Zhuang 2333, 1 I 1998, HMAS 72643; on twig, Pinglongshan, Shangsi, alt. 500 m, W.-p. Wu, S.-l. Chen & W.-y. Zhuang 2341, 2349, 2 I 1998, HMAS 72644, 72645.

Proliferodiscus inspersus var. *magniascus* W. Y. Zhuang (1989) was described from Shennongjia, Hubei, which has larger asci than the typical variety. The Guangxi collections are identical with *Proliferodiscus inspersus* var. *inspersus* described by Haines & Dumont (1983). This is possibly the most common taxon of the Hyaloscyphaceae in tropical Guangxi even though it is only now recorded from China.

ACKNOWLEDGEMENTS

The author would like to express her deep thanks to Mr. Jian-wei Chen, Director, Department of Nature Reserve, Forestry Bureau of China and Mr. Zi-min Liu and Mr. Zhi-hong Xu of Department of Forestry, Guangxi Province for their kind arrangements of collecting in nature reserves of Guangxi; to Prof. R. P. Korf of Cornell University, USA, for consultation and kindly serving as pre-submission reviewer of this paper; to Dr. B. M. Spooner of the Royal Botanic Gardens, Kew, England for consultation and sending useful reprints; to Dr. J. H. Haines of New York State Museum, USA for consultation; to Dr. Wen-ping Wu of Novo Nordisk China, Dr. Shuang-lin Chen and Ms. Xiao-qing Zhang of this institute for collecting specimens jointly for this study, and to Dr. Jian-yun Zhuang of this institute for corrections of the Latin diagnoses.

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中国热带盘菌初探之三
广西热带晶杯菌科真菌

庄文颖
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本文报道广西热带大明山、十万大山、那坡等地采集的晶杯菌科真菌 7 属 24 种。其中广西白毛盘菌 *Albotricha guangxiensis*、亚根粒毛盘菌 *Lachnum subpygmaeum*、广西针毛盘菌 *Lasiobelonium guangxiense*、广西近蛛盘菌 *Parachnopeziza guangxiensis* 和中国近蛛盘菌 *Parachnopeziza sinensis* 为新种，（参照）白壳白毛盘菌 *Albotricha* cf. *albotestacea*、金蛛盘菌 *Arachnopeziza aurata*、（参照）软粒毛盘菌毕氏变种 *Lachnum* cf. *apalum* var. *beatonii*、乌毛蕨粒毛盘菌 *Lachnum blechnophilum*、威氏粒毛盘菌 *Lachnum willisii*、粒毛盘菌未定名种 #1 *Lachnum* taxonomic sp. #1、粒毛盘菌未定名种#2 *Lachnum* taxonomic sp. #2 和层出盘菌原变种 *Proliferodiscus inspersus* var. *inspersus* 为我国新记录。

MYCOTAXON

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ADDITIONAL LIST OF PORE FUNGI OF COSTA RICA

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During a collecting trip to Costa Rica in 1991, Ryvarden collected several species not previously reported for this country (Carranza & Saénz, 1984; Carranza-Morse, 1991,1992,1993; Carranza, 1996; Núñez,1994;1996; Ruiz-Boyer, 1966). In 1993, the former author had the opportunity to visit the Department of Biology, at the University of Oslo, sponsored by the Norwegian Government, and worked with Ryvarden on his collection and also on some unidentified specimens from her own collection. Specimens collected later by other researchers are also included.

The species preceded by an asterisk (*) are new records for Costa Rica.

Bondarzewiaceae

Bondarzewia berkeleyi (Fr.) Bondartsev & Singer, Ann. Mycol. 39:47. 1941. **Polyporus berkeleyi** Fr., Nova Symb. p.56. 1851.

Comments: Basidiospores 8.5 - 10 µm in diameter, ornamented, strongly amyloid, larger than reported by Ryvarden and Johansen (1980: 5-7.5 µm in diameter).

Voucher specimen examined: Bosque del Niño, Grecia. Bosque de **Quercus**, 3-8-95, JCV 12-95 (USJ 55311). Specimen collected at 1900 m.

Substratum: On the ground from buried roots of hardwood trees.

Distribution: North and Central America, Europe, Asia.

Corticiaceae

* **Grammothele lineata** Berk. & Curtis, Journ. Linn. Soc. 10:327. 1868. **Grammothele grisea** Berk. & Curtis, Journ. Linn. Soc. 10:327. 1868.
Voucher specimen examined: Bosque nuboso Cacao, Area de Conservación Guanacaste, 1-6-95, M. Núñez 990. Specimen collected at 1600 m.
Substratum: On hardwood trees.
Distribution: Central and South America; Caribbean Islands; Africa.

Ganodermataceae

* **Amauroderma camerarium** (Berk.) Furtado, Rev. Gen. **Amauroderma** (Polyp.). Est. Bas. Microestr. Basid. 140. 1968. **Polyporus camerarius** Berk., J. Bot. & Kew Misc. 8: 143. 1856.
Comments: Basidiospores 8.6-13.9 x 5.3-7.9 µm, narrower than reported by Furtado (1967: 10-13 x 9-11 µm).
Voucher specimen examined: Rio Barú, Puntarenas; L.D. Gómez 21624 (USJ 43843). Specimen collected at 1800 m.
Substratum: On ground.
Distribution: Central and South America.

Amauroderma pseudoboletum (Speg.) Furtado, Rev. Gen. **Amauroderma** (Polyp.). Est. Bas. Microestr. Basid. 230. 1968. **Polyporus pseudoboletus** Speg., Fung. Guaranitici Pug. 1:16. 1883.
Voucher specimens examined: Sixaola, Talamanca, Limón, 28-7-94, A. Ruiz-Boyer 136 (CR173470); margen Río Esquinas, Golfito, Puntarenas, 25-2-95, R. González 61 (CR185132); Parque Nacional Esquinas, Golfito, Puntarenas, 30-9-95, J. Sánchez (CR191466). (Altitudinal distribution: 30-300 m). (Ruiz-Boyer, 1996).
Substratum: On the ground.
Distribution: North, Central and South America.

Hymenochaetaceae

* **Coltricia focicola** (Berk. & Curtis) Murrill, N. Am. Fl. 9:92. 1908. **Polyporus focicola** Berk. & Curtis, J. Linn. Soc. Bot. 10:305. 1868.

Comments: Basidiospores 5.3-8.6 x 3.3-5.3 µm, slightly different than reported by Gilbertson and Ryvarden (1986: 7-11 x 4-5 µm).
Voucher specimen examined: Bagaces, Guanacaste, 29-2-93, L.D. Gómez & R. Alfaro 22108 (USJ 43845). Specimen collected at 80 m.
Substratum: On ground.
Distribution: North and Central America; Caribbean Island.

* **Coltricia montagnei** (Fr.) Murrill, Mycologia 12:13. 1920. **Polyporus montagnei** Fr., in Mont. Ann. Sci. Nat. Bot. ser. 2, 1:341. 1836.

Comments: Basidiospores 10.6-15.2 x 6.6-9.2 µm, larger than reported by Gilbertson and Ryvarden (1986: 9-14 x 5.5-7.5µm).
Voucher specimen examined: Aranjuez, Puntarenas, 4-6-91, L. Ryvarden 29296 (USJ43846). Specimen collected at 50 m.
Substratum: On the ground.
Distribution: North and Central America.

Inonotus patouillardi (Rick) Imaz., Bull. Tokyo Sci. Mus. 6: 105. 1943. **Polystictus patouillardi** Rick, Broteria 6:89. 1907.

Comments: Basidiospores: 7-8 x 3-4 µm (Ruiz-Boyer and Carranza, 1996), slightly different than reported by Ryvarden and Johansen (1980: 4.5-7 x 3.5-5 µm).
Voucher specimen examined: Fila Palmital, Las Tablas, Coto Brus, Puntarenas, A. Ruiz-Boyer, A. Franco-Molano, M. Mata, R. Castro 189 (CR 191641); Reserva Carara, Puntarenas, L. Ryvarden 29819 (USJ 55791). (Altitudinal distribution: 100-1500 m).
Substratum: On hardwood trees.
Distribution: North, Central and South America; Africa.

* **Phellinus callimorphus** (Lév.) Ryvarden, Prel. Polyp. Fl. East Africa, p.145. 1980. **Polyporus callimorphus** Lév., Ann. Sci. Nat. Ser. 5, Vol. 5:133.1846.

Voucher specimen examined: Bosque nuboso Cacao, Area Conservación Guanacaste, 14-6-95, M. Núñez 982. Specimen collected at 1600 m.
Substratum: On hardwood trees.
Distribution: Central and South America; Africa.

* **Phellinus contiguus** (Pers.:Fr.)Pat., Essai Taxon., p.97. 1900. **Boletus contiguus** Pers., Synop. Meth. Fung., p.544. 1801. **Polyporus contiguus** Fr., Syst. Mycol. 1:378. 1821.
Comments: Setae 14.5-34.3 x 5.9-7.3 (-11.9)µm.
Voucher specimen examined: Universidad para la Paz, Ciudad Colón, San José, L. Ryvarden 29715 (USJ 43882). Specimen collected at 840 m.
Substratum: On hardwood and softwood trees.
Distribution: North, Central and South America; Caribbean Islands; Europe; Asia; Australia; New Zealand; Africa.

* **Phellinus durissimus** (Lloyd) Roy, Mycologia 71:1006. 1979. **Fomes durissimus** Lloyd, Mycol. Writ. 6:943. 1920.
Comments: Basidiospores 6-7 x 4-5 µm, larger than reported by Larsen and Cobbe-Poulle (1990: 3.5-5 x 3.5-4 (4.5)µm).
Voucher specimen examined: Cerca del Río Barú, Puntarenas; L.D. Gómez 21728 (USJ 44019). Specimen collected at 1800m.
Substratum: On hardwood trees.
Distribution: North and Central America; Asia; Africa.

* **Phellinus ferruginosus** (Schrad.:Fr.) Pat., Essai Taxon., p.97. 1900. **Boletus ferruginosus** Schrad., Spic. Fl. Germ., p.172. 1794.
Comments: Setae straight, up to 60 µm long.
Voucher specimen examined: Estación Biológica La Selva, Puerto Viejo, Sarapiquí, Heredia, J.Carranza 294-86 (USJ54858). Specimen collected at 37 m.
Substratum: On hardwood and softwood trees.
Distribution: North and Central America; Europe, Africa.

* **Phellinus grenadensis** (Murrill) Ryvarden, Norw. J. Bot. 18(3-4):234. 1972. **Pyropolyporus grenadensis** Murrill, North Amer. Flora 9:107. 1908.
Comments: Basidiospores 6 x 4-5 µm.
Voucher specimen examined: Santa Rosa, bosque seco, Guanacaste, 12-6-95, M. Núñez 974. Specimen collected at

300 m.
Substratum: On hardwood trees.
Distribution: Central and South America; Africa.

* **Phellinus pachyphloeus** (Pat.)Pat., Essai Taxon., p. 97. 1900. **Polyporus pachyphloeus** Pat., J. Bot. (Morot) 3:257. 1889.
Comments: No spores observed. Setal hyphae up to 400 µm long.
Voucher specimen examined: Turrialba, Cartago, 23-5-91, L. Ryvarden 29071 (USJ 44020). Specimen collected at 646 m.
Substratum: On hardwood and softwood trees.
Distribution: Central and South America; Africa; Asia; Australia; New Zealand; Caribbean Islands.

Polyporaceae

* **Amylosporus bracei**(Murrill)A.David & Rajchenb., Mycotaxon 22:288. 1985. **Poria bracei** Murrill., Mycol. 13: 91. 1921.
Comments: Basidiospores 2.5-3 x 2-2.5 µm, smaller than reported by Rajchenberg (1983: 3.1-3.6 x 2.6 µm).
Voucher specimen examined: Monteverde, Puntarenas, 11-11-87, J. Carranza 254-87 (USJ 53646). Specimen collected at 1330 m).
Substratum: On hardwoods.
Distribution: Central and South America; Caribbean Islands.

* **Antrodiella hydrophila** (Berk. & Curtis) Ryvarden, Mycotaxon 20:343. 1984. **Polyporus hydrophilus** Berk. & Curtis, J. Linn. Soc. Bot. 10:306. 1868.
Comments: Basidiospores 2-3 x 2 µm.
Voucher specimen examined: Bosque nuboso Cacao, Area de Conservación Guanacaste, 14-6-95, M. Núñez 989. Specimen collected at 1600 m.
Substratum: On hardwood trees.
Distribution: Central America; Caribbean Islands.

Antrodiella liebmannii (Fr.)Ryvarden, Prel. Polyp. Fl. East Africa, p.258. 1980. **Polyporus liebmannii** Fr., Nova Acta Reg. Soc. Sci. Upsal. III, 1:59. 1851.
Comments: Basidiospores 2.7-3.3 x 1.5-2.2 µm.
Voucher specimen examined: Estación Biológica La Selva,

Puerto Viejo, Sarapiquí, Heredia; 10-6-91,L. Ryvarden 29555 (USJ 53650); Estación Biol. La Selva, Sarapiquí, Heredia, C. Ovrebo 3300; San Ramón, Alajuela, 7-6-91, L. Ryvarden, 29507 (Altitudinal distribution: 37-850 m). (Núñez, 1996).
Substratum: On hardwood trees.
Distribution: North, Central and South America; Caribbean Islands; Africa.

* **Antrodiella murrillii** (Lloyd) Ryvarden, Mycotaxon 38:93. 1990. **Polyporus murrillii** Lloyd, Lloyd Mycol. Writ. 5:857. 1919.
Voucher specimen examined: Reserva de San Ramón, Alajuela, 7-6-91, L. Ryvarden & M. Núñez 19. Specimen collected at 850 m). (Ryvarden, 1990).
Substratum: On hardwood trees.
Distribution: Central America.

* **Ceriporia viridans** (Berk. & Broome)Donk, Med. Bot. Mus. Univ. Utrecht 9:171. 1933. **Polyporus viridans** Berk. & Broome, Ann. Mag. Nat. Hist., Ser. 3, 7:379. 1861.
Comments: Basidiospores 3.3-3.8 x 1.6 µm, smaller than reported by Ryvarden and Johansen (1980: 3-5 x 1.5-2.5 µm).
Voucher specimen examined: Santa Rosa, Guanacaste, 29-4-93, M. Núñez (USJ 43844). Specimen collected at 300 m).
Substratum: On hardwood rarely on softwood trees.
Distribution: North and Central America; Africa.

* **Ceriporiopsis flavilutea** (Murrill) Ryvarden, Mycotaxon 23:185. 1985. **Poria flavilutea** Murrill, Lloydia 10:50. 1947.
Comments: Basidiospores 2.8-3.9 x 1.7-2.2 µm.
Voucher specimen examined: Estación Biológica La Selva, Puerto Viejo, Sarapiquí, Heredia, 10-6-91, L. Ryvarden 29554 (USJ 53649). Specimen collected at 37 m.
Substratum: On hardwood trees.
Distribution: Central America; Caribbean Islands.

* **Ceriporiopsis mucida** (Pers.:Fr.) Gilb. & Ryvarden, Mycotaxon 22:364. 1985. **Polyporus mucidus** Pers.:Fr., Syst. Mycol. 1:382. 1821.
Comments: Basidiospores 2 x 1.5 µm, smaller than reported by Gilbertson and Ryvarden (1987: 2.5-3.5(4) x 2-2.5 µm).

Voucher specimen examined: Estación Biológica La Selva, Puerto Viejo, Sarapiquí, Heredia, 24-6-91, L. Ryvarden 30029 (USJ 53639). Specimen collected at 37 m.
Substratum: On hardwood and softwood trees.
Distribution: North and Central America; Europe.

* **Cristelloporia dimitica** Johansen & Ryvarden, Trans. Br. Mycol. Soc. 72: 189. 1979.

Comments: Basidiospores 4-6 x 3-4 µm, bigger than reported by Ryvarden and Johansen (1980: (3.5) 4-5 x 3-3.5 µm).
Voucher specimen examined: Aranjuez, Puntarenas, 4-6-91, L. Ryvarden 29282 (USJ 44016). Specimen collected at 50 m.
Substratum: On hardwood trees.
Distribution: Central America; Africa.

Henningsia brasiliensis (Speg.)Speg.,Bol. Acad. Nac. Cienc. Cordoba 23:411. 1919. **Polyporus brasiliensis** Speg., Bol. Acad. Nac. Cienc. Cordoba 11(4):436. 1889.

Comments: Basidiospores 4.6-7.3 x 4-4.6 µm.
Voucher specimen examined: Estación Biológica Pitilla, Volcán Orosi, Guanacaste, 7-5-93, M. Núñez (USJ 43848). Specimen collected at 600 m. (Núñez, 1994).
Substratum: On hardwood trees.
Distribution: Central and South America.

* **Junghuhnia carneola** (Bres.) Rajchenb., Rev. Invest. Agrop. 19:45. 1984.

Comments: Basidiospores 6 x 4 µm.
Voucher specimen examined: Reserva Carara, Puntarenas, L. Ryvarden 29864 (USJ 55795). Specimen collected at 7 m.
Substratum: On hardwood trees.
Distribution: Central and South America.

* **Junghuhnia nitida** (Fr.) Ryvarden, Persoonia 7, 1:18. 1972. **Polyporus nitidus** Fr., Syst. Mycol. 1:379. 1821.
Voucher specimen examined: Santa María de Dota, San José; L. Ryvarden 29009 (USJ 53640). Specimen collected at 2021m.
Substratum: On hardwood rarely on softwood trees.
Distribution: North, Central and South America; Africa; Europe.

* **Junghuhnia semisupiniformis** (Murrill) Ryvarden, Mycotaxon

23:195. 1985. **Tyromyces semisupiniformis** Murrill, Bull. New York Bot. Gard. 8:148.1912.
Voucher specimen examined: Universidad para la Paz, Ciudad Colón, San José; 6-13-91, L. Ryvarden, 29683. Specimen collected at 840 m.
Substratum: On hardwood trees.
Distribution: North and Central America.

*** Laetiporus persicinus** (Berk. & Curtis) Gilb., Mycotaxon 12:385. 1981. **Polyporus persicinus** Berk. & Curtis, Grevillea 1:37. 1872.
Voucher specimen examined: Turrialba, Cartago, 25-5-91, L. Ryvarden 29053 (USJ 53637). Specimen collected at 646 m.
Substratum: On hardwood and softwood trees.
Distribution: North and Central America.

*** Nigroporus durus** (Jungh.) Murrill, Bull. Torrey Bot. Cl.34:471. 1907. **Polyporus durus** Jungh., Verh. Batav. Genootsch. 17:62. 1838.
Voucher specimen examined: Laguna Hule, Alajuela, 23-5-91, L. Ryvarden 28933 (USJ43849). Specimen collected at 740 m.
Substratum: On hardwood trees.
Distribution: Central America, Africa; Asia.

*** Oligoporus tephroleucus** (Fr.) Gilb. & Ryvarden, Mycotaxon 22:365. 1985. **Polyporus tephroleucus** Fr., Syst. Mycol. 1:360. 1821.
Comments: Basidiospores: 3-4 x 1-1.5 µm, smaller than reported by Gilbertson and Ryvarden (1987:4.5-6 x 1-1.5µm).
Voucher specimen examined: Estación Biológica La Selva; Puerto Viejo de Sarapiquí, Heredia, 24-6-91, L. Ryvarden 30037 (USJ 53643). Specimen collected at 37 m.
Substratum: On hardwood and softwood trees.
Distribution: North and Central America; Europe.

*** Pachykytospora alabamae** (Berk. & Cooke) Ryvarden, Norw. J. Bot. 19(3-4) 123. 1972. **Polyporus alabamae** Berk. & Cooke, Grevillea 6:130. 1878.
Commments: Basidiospores 9.9-14.5 x 5.3-6.6 µm, larger than reported by Ryvarden and Johansen (1980: 9-12 x 4-6 µm).
Voucher specimen examined: Universidad para La Paz, Ciudad Colón, San José, 13-6-91, L. Ryvarden 29715 (USJ 43882).

Specimen collected at 840 m.
Substratum: On hardwood and softwood trees.
Distribution: North, Central and South America; Asia.

* **Perenniporia micropora** Ryvarden, Mycotaxon 28:533. 1987.
Comments: Basidiospores 5-6 x 4-5 µm.
Voucher specimen examined: Reserva Carara, Puntarenas, L. Ryvarden 29822 (USJ 55794). Specimen collected at 7 m.
Substratum: On hardwood trees.
Distribution: Central and South America.

* **Perenniporia narymica** (Pil.)Pouzar, Ceska Mykol. 38:204. 1984. **Trametes narymica** Pil., Bull. Soc. Mycol. Fr. 51:364. 1936.
Voucher specimen examined: Santa María de Dota, San José, L. Echeverría 105-79. Specimen collected at 2021 m.
Substratum: On hardwood trees.
Distribution: North and Central America; Europe; Asia.

* **Perenniporia rosea-isabellina** (Pat. & Gail) Ryvarden, Farlow Herb. Papers 18:32. 1983. **Polyporus roseoisabellinus** Pat. & Gail, BSMF 4:35. 1888.
Comments: Basidiospores 5-7.2 x 3.9-6.1 µm, smaller than reported by Ryvarden (1983: 7-9 x 5-7 µm).
Voucher specimen examined: Estación Biológica La Selva, Puerto Viejo, Sarapiquí, Heredia, 10-6-91, L. Ryvarden 29603 (USJ 53677). Specimen collected at 37 m.
Substratum: On hardwood trees.
Distribution: Central and South America.

* **Porodisculus pendulus** (Schw.) Murrill, N. Am. Flora 9:47. 1907. **Peziza pendula** Schw., Schr. Nat. Ges. Leipzig 1:92. 1822.
Voucher specimen examined: Santa María de Dota, San José, J. Carranza 251-87 (USJ 53648). Specimen collected at 2021m.
Substratum: On hardwood trees.
Distribution: North, Central and South America; Asia; Africa.

* **Pseudofavolus miquelii** (Mont.)Pat., Essai Tax. Hymen. p.81. 1900. **Polyporus miquelii** Mont., Ann. Sci. Nat. III,

4:357. 1845.
Voucher specimen examined: Estación Biológica La Selva, Puerto Viejo, Sarapiquí, Heredia, L. Núñez 16-91. Specimen collected at 37 m.
Substratum: On hardwood trees.
Distribution: Central America; Africa.

Pyrofomes lateritius (Cooke) Ryvarden, Norw. J. Bot. 19:236. 1972.
Comments: Basidiospores: 5-6 x 3-4 µm (Ruiz-Boyer and Carranza, 1996).
Voucher specimen examined: Sierpe de Osa, Puntarenas, A. Ruiz-Boyer, G. Vargas, G. Herrera 57 (CR 182841) (Altitudinal distribution: 20-400 m).
Substratum: On hardwood (Sapotaceae).
Distribution: North, Central and South America.

Rigidoporus biokoensis (Lloyd) Ryvarden, Norw. J. Bot. 19:236. 1972. **Polyporus biokoensis** Lloyd, Lloyd's Mycological Writings 3: Stip. 131. 1912.
Comments: Basidiospores 4-5.9 x 3.3-6 µm, bigger than reported by Ryvarden and Johansen (1980: 4-4.5 µm diameter).
Voucher specimen examined: Aranjuez, Puntarenas, 4-6-91, L. Ryvarden 29302 (USJ43850). Specimen collected at 50 m. (Núñez, 1996).
Substratum: On hardwood trees.
Distribution: Central America; Africa.

* **Schizopora flavipora** (Cooke) Ryvarden, Mycotaxon 23: 186. 1985. **Poria flavipora** Cooke, Grevillea 15:25. 1886.
Voucher specimen examined: Santa María de Dota, San José; L. Ryvarden 29023 (USJ 53642). Specimen collected at 2021m.
Substratum: On hardwood trees.
Distribution: North and Central America.

* **Skeletocutis niveicolor** (Murrill) Ryvarden, Mycotaxon 23:187. 1985. **Poria niveicolor** Murrill, Mycologia 12:84. 1920.
Comments: Basidiospores 4-4.5 x 3-4 µm, bigger than reported by Ryvarden (1985: 2.5-3 x 1.5-2 µm).
Voucher specimen examined: Estación Biológica La Selva,

Puerto Viejo, Sarapiquí, Heredia, 10-6-91, L. Ryvarden 30072-B (USJ 55796). Specimen collected at 37 m.
Substratum: On hardwood trees.
Distribution: Central America.

* **Trametes ectypus** (Berk. & Curtis) Gilb. & Ryvarden, North American Polypores, p.740. 1987. **Polyporus ectypus** Berk. & Curtis, Grevillea 1:52, 1872.
Voucher specimens examined: Laguna Hule, Alajuela. L. Ryvarden 28957 (USJ 53638). Specimen collected at 740 m.
Substratum: On hardwoods.
Distribution: North, Central and South America; Caribbean Islands; Asia.

Trametes elegans (Spreng.:Fr.) Fr., Epicr. Syst. Mycol. p.492. 1838. **Daedalea elegans** Spreng.:Fr., Syst. Mycol. 1:335. 1821.
Voucher specimens examined: Frailes, San José, 25-7-79, J.Carranza 4-79 (USJ 21125); Palomo, Orosí, Cartago, 30-8-79, J.Carranza 20-79 (USJ21126); Guayacán, Limón, J.Carranza 94-80 (USJ 21266); La Selva, Puerto Viejo, Sarapiquí, Heredia, 4-7-86, J.Carranza 258-86 (USJ 27512); Bello Horizonte, Escazú, San José, 17-7-95, J.Carranza 11-95 (USJ). (Altitudinal distribution: 37-1615 m).
Substratum: On hardwoods (**Dalbergia retusa**).
Distribution: North, Central and South America; Africa; Asia.

Trametes modesta (Fr.) Ryvarden, Norw. J. Bot. 19:236. 1972. **Polyporus modestus** Fr., Linnaea 5:519. 1830.
Comments: Spores 7-9 x 4 µm, bigger than reported by Gilbertson and Ryvarden (1987: 4.5-6 x 1.5-2(2.5) µm), and Fidalgo and Fidalgo (1968: 6-7.5 x 3.5-4 µm).
Voucher specimen examined: Cuenca Río Enmedio, Santa Cruz, Guanacaste, 13-4-84, R. Alfaro 52 (USJ 44015), Santa Rosa, Guanacaste, 3-6-94, J.Carranza 13-94. (Altitudinal distribution: 26-300 m).(Núñez, 1996).
Substratum: On hardwood trees.
Distribution: North, Central and South America; Africa; Asia, Australia.

* **Trametes ochracea** (Pers.) Gilb. & Ryvarden, N. Am. Polyp.

1987. **Boletus ochraceus** Pers., Ann. Bot. (Usteri) 11:29. 1794.
Voucher specimen examined: Volcán Poás, Alajuela, 2-6-91, L. Ryvarden 29220 (USJ 53678). Specimen collected at 1300m.
Substratum: On hardwood and softwood trees.
Distribution: North and Central America; Europe.

*** Trametes varians** Van der Byl, South Afr. J. Sci. 18:281. 1922. **Polyporus radiatorugosus** Bres., Ann. Mycol. 18:36. 1920.
Comments: Basidiospores 5 x 3 µm.
Voucher specimens examined: Santa María de Dota, Jardín, San José, L. Echeverría 36-78 (USJ 53641). Specimen collected at 2021 m.
Substratum: On hardwood trees.
Distribution: Central America; Africa.

*** Tyromyces chioneus** (Fr.) Karst., Rev. Mycol. 3:17. 1881. **Polyporus chioneus** Fr., Syst. Mycol. 1:359. 1821.
Comments: Basidiospores 4-5 x 1.5 µm.
Voucher specimen examined: Bosque nuboso Cacao, Area de Conservación Guanacaste, 14-6-95, M. Núñez 986. Specimen collected at 1600 m.
Substratum: On hardwood trees.
Distribution: North and Central America; Europe.

*** Tyromyces leucomallus** (Berk. & Curtis) Murrill, N. Am. Flora 9:36. 1907. **Polyporus leucomallus** Berk. & Curtis, J. Linn. Soc. Bot. 10:308. 1868.
Comments: Basidiospores 4 x 1 µm.
Voucher specimen examined: Universidad para La Paz, Ciudad Colón, San José, 13-6-91, L. Ryvarden 29714 (USJ 53644). Specimen collected at 840m.
Substratum: On hardwood trees.
Distribution: North and Central America; Europe.

*** Tyromyces pseudolacteus** Murrill, Bull. Torrey Bot. Club 67:65. 1940.
Comments: Basidiospores 5.3-5.9 x 4-4.6 µm, bigger than reported by Gilbertson and Ryvarden (1987:4-5 x 2.5-3.5µm).
Voucher specimen examined: Estación Biológica La Selva, Puerto Viejo, Sarapiquí, Heredia, 10-6-91, L. Ryvarden

30061 (USJ 43881). Specimen collected at 37m.
Substratum: On hardwood trees.
Distribution: North and Central America.

Wrightoporia tropicalis (Cooke) Ryvarden, Prel. Polyp. Fl. East Africa, p.619. 1980. **Fomes tropicalis** Cooke, Grevillea 15:22. 1886.

Comments: Spores 4-5 x 4 µm, bigger than reported by Ryvarden and Johansen (1980: 3-4 x 2-2.5 µm).
Voucher specimen examined: Estación Biológica Pitilla, Area Conservación Guanacaste, M. Núñez 221 (USJ44018). Estación Biológica La Selva, Puerto Viejo, Sarapiquí, Heredia, L. Ryvarden 29602 (USJ44017). (Altitudinal distribution: 37-600 m).
Substratum: On hardwood trees.
Distribution: Central and South America; Caribbean Islands; Africa.

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MELIOLACEAE OF KERALA - V

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Summary

This paper gives an account of five meliolaceous fungi. Of these, *Meliola integripoda*, *M. pequensis* and *M. surattensis* are new species; *Meliola cookeana* Speg. var. *viticis* Hansf. is reported for the first time from India, while *Meliola anceps* H.& P. Sydow is found on an extensively cultivated ornamental plant.

1. *Meliola anceps* H. & P. Sydow, Ann. Mycol. 14: 76, 1916; Hansford, Sydowia Beih. 2: 256, 1961; Hosagoudar & Goos, Mycotaxon 37: 218, 1990.

= *Meliola mussaendae* H. & P. Sydow, Ann. Mycol.15:190.1917.
≡ Meliola anceps var. mussaendae (H. & P. Sydow) F.L. Stevens, Ann. Mycol. 26:205-206. 1928.

On leaves of *Mussaenda philippica* A. Rich. (Rubiaceae), in the garden of Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, Kerala, India, Dec. 12, 1996, V.B. Hosagoudar HCIO 42419.

This host plant has been extensively cultivated and the pathogen appears to be a threat to it.

2. *Meliola cookeana* Speg. var. *viticis* (Hansf.) Hansf., Sydowia Beih. 2: 690, 1961. (Fig. 1).

≡ *Meliola clerodendricola* Henn. var. *viticis* Hansf., Proc. Linn. Soc. London 153: 9, 1941.
≡ *Meliola rizalensis* H. & P. Sydow var. *viticis* (Hansf.) Hansf. & Deight., Mycol. Pap. IMI 23: 70, 1948.
=*Meliola clerodendri* Yamam., Trans. Nat. Hist. Soc. Formosa 30: 418, 1940 (non Hansf., 1937).

Colonies amphigenous, mostly epiphyllous, dense, velvety, up to 5 mm in diameter, confluent and covering the entire upper surface of the leaves.

Hyphae flexuous, branching alternate to irregular at acute angles, loosely to closely reticulate, cells 19-24 × 4.5-5.5 µm. Hyphopodia alternate, antrorse, straight to curved, 14-23 µm long; stalk cells cylindrical to cuneate, 4.5-9.5 µm long; head cells ovate, globose, entire, rarely slightly angular, 9.5-13 × 9.5-11 µm. Phialides numerous in some colonies, mixed with hyphopodia, alternate to opposite, ampulliform, 14-16 × 6-8 µm. Mycelial setae scattered to grouped around perithecia, straight to slightly curved or rarely geniculate, broadly obtuse to 2-3 times furcate, the branches up to 30 µm long, setae up to 245 µm long. Perithecia scattered to loosely grouped, verrucose, up to 130 µm in diam.; ascospores cylindrical, 4-septate, slightly constricted at the septa, 28-30.5 × 9.5-11.5 µm.

On leaves of *Clerodendrum serratum* (L.) Moon (Verbenaceae), in the garden of Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, Kerala, India, Dec. 4, 1996, V.B. Hosagoudar HCIO 42421.

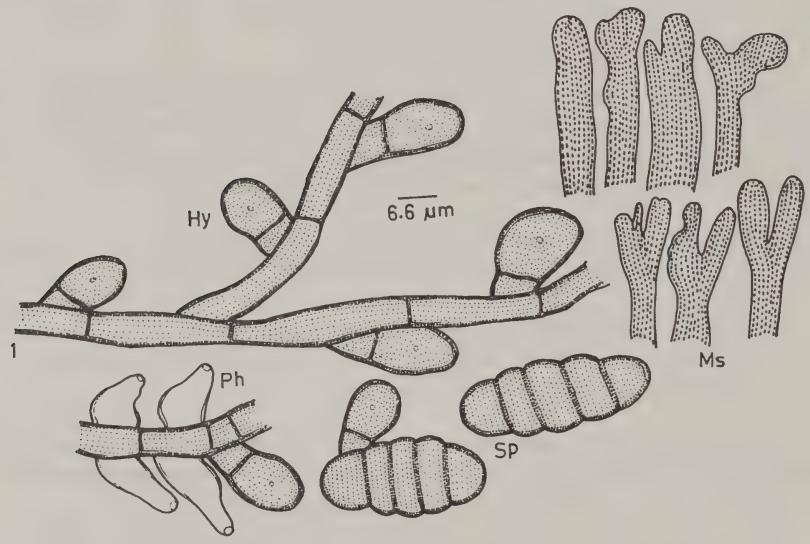


Fig. 1. *Meliola cookeana* Speg. var. *viticis* Hansf. Hy = Hyphopodia; Ms = Mycelial setae; Ph = Phialides; Sp = Ascospores.

This species was known from Uganda, Indonesia: Java, Malaya and Taiwan (as Formosa, Hansford, 1961) and is reported here for the first time from India (Hosagoudar, 1996). The present collection having slightly smaller ascospores.

3. *Meliola integripoda* sp. nov. (Fig. 2)

Coloniae plerumque epiphyllae, raro amphigenae, subdensae vel densae, ad 2 mm diam., confluentes. Hyphae rectae vel subrectae, irregulariter

acuteque ramosae, laxe vel fortiter dense reticulatae, cellulae 12-16 × 4.5-5.5 µm. Hyphopodia alternata, antrorsa, 19-24 µm longa; cellula basali cylindracea vel cuneata, 3-6.5 µm longa; cellula apicali ovata, cylindracea, attenuata et late rotundata ad apicem, integra, 16-18 × 8-10 µm. Phialides in hyphis separatis, alternatis vel oppositis, ampullaceus, 11-16 × 6-8 µm. Setae myceliales paucae vel numerosae, simplices, rectae, leviter flexuosae vel geniculatae ad portionio subapicem, acutae vel obtusae ad apicem, ad 441 µm longae. Perithecia dispersa, ad 136 µm diam.; ascosporae obovoideae vel cylindraceae, 4-septatae, constricatae, 35-36 × 16-18 µm.

Colonies mostly epiphyllous, rarely amphigenous, subdense to dense, up to 2 mm in diameter, confluent. Hyphae straight to substraight, branching irregular at acute angles, loosely to very closely reticulate, cells 12-16 × 4.5-5.5 µm. Hyphopodia alternate, antrorse, 19-24 µm long; stalk cells cylindrical to cuneate, 3-6.5 µm long; head cells ovate, cylindrical, attenuated and broadly rounded at the apex, entire, 16-18 × 8-10 µm. Phialides borne on a separate

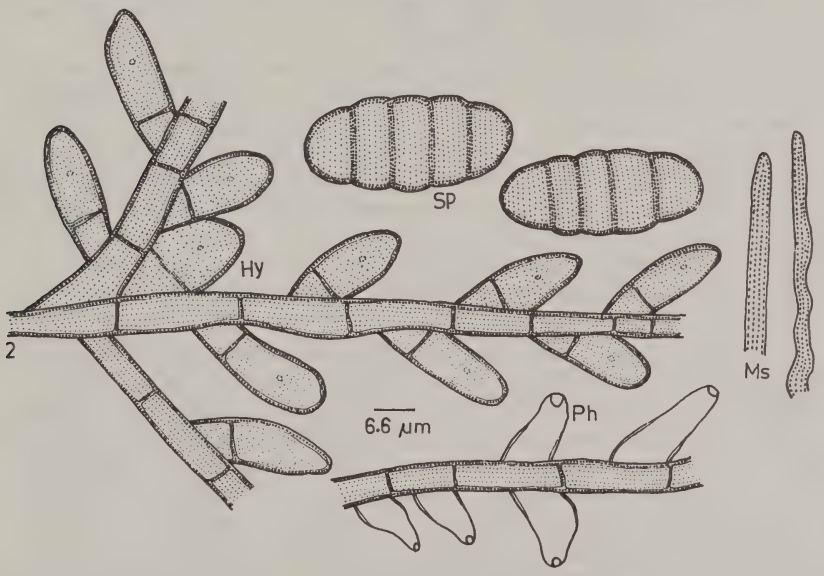


Fig. 2. *Meliola integripoda* sp. nov. Hy = Hyphopodia; Ms = Mycelial setae; Ph = Phialides; Sp = Ascospores.

mycelial branch, alternate to opposite, ampulliform, 11-16 × 6-8 µm. Mycelial setae few to many, simple, straight, slightly flexuous to geniculate at subapical portion, acute to obtuse at the tip, up to 441 µm long. Perithecia scattered, up to 136 µm in diam.; ascospores obovoidal to cylindrical, 4-septate, constricted at the septa, 35-36 × 16-18 µm.

Holotype: On leaves of *Carissa carandas* L. (Apocynaceae), in the garden of Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, Kerala, India, Dec. 4, 1996, V.B. Hosagoudar HCIO 42422.

Etym: L. *integro*, to renew, *podo*, in Gr. comp, foot.

Meliola carissae Doidge and its three varieties are known on the host genus *Carissa* (Hansford, 1961; Hosagoudar, 1996). The present new species differs from these in having entire hyphopodia. According to Beeli formula 3111.3222, the present new species can be compared with *Meliola modesta* H. Sydow but differs from it in the absence of arachnoid colonies, having smaller hyphopodia and mycelial setae.

4. *Meliola pequensis* sp. nov. (Fig. 3)

Coloniae epiphyllae, subdensae vel densae, circumcinctus per luteus halos, portionia folia inferne lutea, ad 5 mm diam., raro confluentes. Hyphae rectae, subrectae, flexuosae vel leniter anfractuae, alternate, opposite et irregulariter acuteque vel laxe ramosae, laxe vel dense reticulatae, cellulae 14-21 × 6-8 µm. Hyphopodia alternata, ad 5% opposita, recta vel curvula, antrorsa, subantrorsa vel recurvata, 14-19.5 µm longa; cellula basali cylindracea vel cuneata, 3-6.5 µm longa; cellula apicali ovata oblonga, globosa, recta vel curvula, rotunda vel truncata ad apicem, 9.5-13 × 8-9.5 µm. Phialides pauca, illis hyphopodiis commixta, alternata vel opposita, ampullacea, 16-20 × 7-9 µm. Setae myceliales dispersae, simplices, rectae, acutae ad apicem, ad 245 µm longae. Perithecia dispersa, ad 130 µm diam.; ascosporae oblongae vel cylindraceae, 4-septatae, leviter constrictae, 30-32 × 11-13 µm.

Colonies epiphyllous, subdense to dense, surrounded by yellow haloes, corresponding lower surface of the leaf area turned yellow, up to 5 mm in diameter, rarely confluent. Hyphae straight, substraight, flexuous to slightly crooked, branching alternate, opposite to irregular at acute to wide angles, loosely to closely reticulate, cells 14-21 × 6-8 µm. Hyphopodia alternate, about 5% opposite, straight to curved, antrorse, subantrorse to recurved, 14-19.5 µm long; stalk cells cylindrical to cuneate, 3-6.5 µm long; head cells ovate, oblong, globose, straight to curved, rounded to truncate at the apex, 9.5-13 × 8-9.5 µm. Phialides few, mixed with hyphopodia, alternate to opposite, ampulliform, 16-20 × 7-9 µm. Mycelial setae scattered, simple, straight, acute at the apex, up to 245 µm long. Perithecia scattered, up to 130 µm in diam.; ascospores oblong to cylindrical, 4-septate, slightly constricted, 30-32 × 11-13 µm.

Holotype: On leaves of *Millettia pequensis* Ali (*M. ovalifolia* Auct.) (Fabaceae), in the garden of Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, Kerala, India, Dec. 4, 1996, V.B. Hosagoudar HCIO 42430.

Etym.: Named for the specific epithet of host.

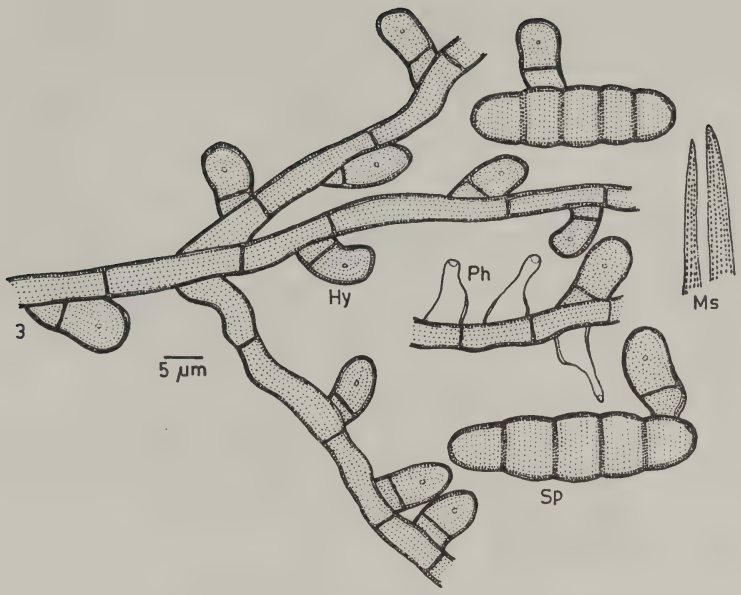


Fig. 3. *Meliola pequensis* sp. nov. Hy = Hyphopodia; Ms = Mycelial setae; Ph = Phialides; Sp = Ascospores.

According to Beeli formula 3113.3221, the present species is close to *Meliola nyanzae* Hansf. and *M. erythrynae-micropterycis* Hansf. (Hansford, 1961). It differs from the former species in the morphology of the head cells of the hyphopodia and the phialides mixed with the hyphopodia. It differs from the latter species in having longer and only 5% opposite hyphopodia, and only straight mycelial setae. It also differs from *Meliola phaseoli* Thite ex Hosag. in causing pathogenic effect on the host plant (Hosagoudar, 1996).

5. *Meliola surattensis* sp. nov. (Fig. 4)

Coloniae hypophyllae, tenues vel subdensae, patentiae, ad 3 mm diam., confluentes. Hyphae flexuosae vel anfractuae, alternate, opposite vel irregulariter acuteque vel laxe ramosae, laxe vel dense reticulatae, cellulae 17-22 × 4-5.5 µm. Hyphopodia alternata, ad 5% opposita, recta vel varie curvula, antrorsa, subantrorsa vel patentia, 11-19 µm longa; cellula basali cylindracea vel cuneata, 3-5 µm longa; cellula apicali ovata, globosa, oblonga, late rotundata vel truncata ad apicem, 8-11.5 × 8-9.5 µm. Phialides dispersis, illis capitatis commixtis, alternatis vel oppositis, ampullaceus, 12-16 × 6-8 µm. Setae myceliales non numerosae, simplices, rectae, acutae vel obtusae ad apicem, ad 343 µm longae. Perithecia dispersa, globosa, ad 100 µm diam.; ascosporae cylindraceae, 4-septatae, leviter constrictae, 28-32 × 9-13 µm.

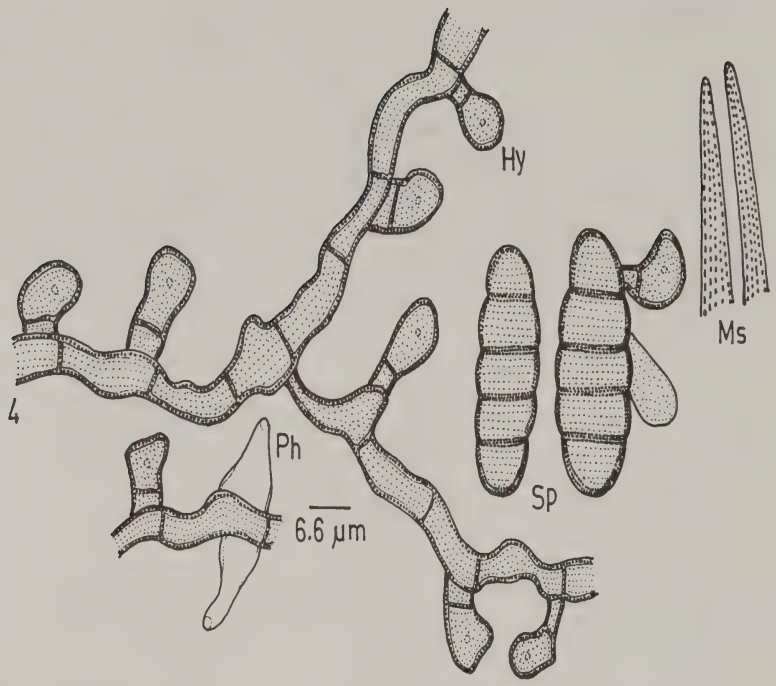


Fig. 4. *Meliola surattensis* sp. nov. Hy = Hyphopodia; Ms = Mycelial setae; Ph = Phialides; Sp = Ascospores.

Colonies hypophyllous, thin to subdense, spreading, up to 3 mm in diam., confluent. Hyphae flexuous to crooked, branching alternate, opposite to irregular at acute to wide angles, loosely to closely reticulate, cells 17-22 × 4-5.5 µm. Hyphopodia alternate, 5% opposite, straight to variously curved, antrorse, subantrorse to spreading, 11-19 µm long; stalk cells cylindrical to cuneate, 3-5 µm long; head cells ovate, globose, oblong, entire to broadly rounded to truncate at the apex, 8-11.5 × 8-9.5 µm. Phialides scattered, mixed with hyphopodia, alternate to opposite, ampulliform, 12-16 × 6-8 µm. Mycelial setae not numerous, simple, straight, acute to obtuse at the tip, up to 343 µm long. Perithecia scattered, up to 100 µm in diam.; ascospores cylindrical, 4-septate, slightly constricted at the septa, 28-32 × 9-13 µm.

Holotype: On leaves of *Cassia surattensis* Burm. (*C. glauca* Lam.) (Caesalpiniaceae), in the garden of Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, Kerala, India, Nov. 13, 1996, V.B. Hosagoudar HCIO 42431.

Etym.: Named for the specific epithet of host.

Meliola aethiops Sacc. and 3 varieties are known on the host genus *Cassia* (Hansford, 1961; Hosagoudar, 1996). The present new species differs from all these in having hypophyllous colonies, flexuous to crooked hyphae, 5% opposite and variously curved hyphopodia.

ACKNOWLEDGEMENTS

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A NEW SPECIES IN THE GENUS SOLENOPSORA (CATILLARIACEAE, LECANORALES)

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ABSTRACT: The species *Solenopsora elixiana* Verdon & Rambold, a small-foliose lichen from south-east Queensland and La Réunion, is described as new to science. It shares several similarities with *S. holophaea* (Mont.) Samp., the probably closest species of the genus. The differences between the two species include color and pruina of thallus, the shape of lobes, structure of thallus cortex and of rhizines, as well as secondary compounds.

KEY WORDS: Australia, La Réunion, lichenized Ascomycetes, lobaric acid.

INTRODUCTION

The majority of taxa with stipitate (i. e. podetiate or pseudopodetiate) apothecia and subsquamulose to squamulose or small-foliose thallus have traditionally been placed in the family Cladoniaceae. Since the taxonomic relevancy of amyloid structures in the ascus apex has been recognized especially in studies by the 'French School' (e. g. CHADEFAUD 1969, LETROUIT-GALINOU 1973), it became obvious that habit and growth form

have developed convergently in several non-related lichen groups. Consequently, some genera had to be excluded from the Cladoniaceae, e. g., *Glossodium* Nyl., which has recently been transferred into synonymy with *Icmadophila* Trev. (RAMBOLD *et al.* 1993). A similar combination of (sub-)stipitate apothecia with a relatively high diversity of thallus morphology is present in *Solenopsora*. As in Cladoniaceae, thallus morphology is quite characteristic at species level in this genus, whereas apothecial micro-morphology seems to be relatively uniform. This high degree of variation is best demonstrated by the differences in the thallus morphology and the arrangement of the apothecia in *Solenopsora holophaea* (Mont.) Samp. and *S. candicans* (Dicks.) Steiner. The thallus of *S. holophaea* is small-foliose, or 'squamulose' according to the terminology of several authors (e. g. PURVIS & JAMES 1992), and the apothecia are sessile to shortly stipitate, whereas *S. candicans* has a placodioid thallus and emergent to adnate apothecia. Due to the small-foliose thallus and significant apothecial stipes, the new species *Solenopsora elixiana* was initially believed to be a member of the genus *Myelorrhiza* Verdon & Elix (Cladoniaceae). Indeed, *S. elixiana* can quite easily be confused with *Myelorrhiza antrea* Verdon & Elix and even has the same chemistry as that species. However, several differences in hymenial characters, mainly the reaction of the ascus apex in Lugol's solution, exclude the new species from that genus. This iodine reaction in *S. elixiana* shows a totally amyloid tholus without non-amyloid areas as is typical for the Catillariaceae, whereas in *Myelorrhiza* an amyloid ring or tube structure, which is characteristic of the Cladoniaceae, can be observed (VERDON *et al.* 1996). The small-foliose thallus, the absence of a proper excipulum and the presence of a thalline excipulum in combination with septate spores, indicate that this new species has affinity with *S. holophaea.* The circumscription of *Solenopsora* and the delimitation of its species are unsettled and the genus is in need of revision.

MATERIAL AND METHODS

Sections for micro-morphological studies were cut with a freezing microtome (6–12 µm thick) and mounted in lactophenol cotton blue for semi-permanent slides. Measurements were made using water mounts. Hymenial sections were also mounted in diluted Lugol's solution ('I'). Studies of ascospores were made with hymenial squashes in water mounts and studies of pycnidia with sections and squashes in ammoniacal

erythrosin. Septate ascospores were also treated with 10% KOH to study the septa.

The natural compound lobaric acid was characterized by TLC and by HPLC (ELIX & ERNST-RUSSELL 1996, FEIGE *et al.* 1993). For lobaric acid, the correlation of ultraviolet spectra of synthetic and natural material was better than 99.9%.

THE GENUS

Solenopsora A. Massal., Framm. Lich.: 20 (1855).
Type species. *S. requeinii* A. Massal., Framm. Lich.: 20 (1855) = *S. holophaea* (Mont.) Samp., Broteria 19: 28 (1921).

The genus was originally described from Voltri, near Genoa in Italy to accommodate *S. requeinii.* The earliest epithet for this species, however, is due to Montagne who described *P. holophaea* from the Canary Islands (Bas.: *Parmelia holophaea* Mont. in Webb, Iles Can.: 113, 1840). Seventeen species of *Solenopsora* are known from various regions, mainly in the Northern Hemisphere, including Europe, western North Africa, the Canary Islands, Asia and North America (ZAHLBRUCKNER 1925, LAMB 1963, NIMIS 1993, HAWKSWORTH *et al.* 1995). *Solenopsora* has hitherto been reported in Australia from Western Australia (viz.: *S. vulturiensis* A. Massal.; SAMMY 1989, FILSON 1996) and from New South Wales (viz.: *S. candicans* (Dicks.) Stein; FILSON 1996). No records existed from the Mascarene Islands. As a result of the new species described below, the genus is reported here for the first time from Queensland and from La Réunion.

THE NEW SPECIES

Solenopsora elixiana Verdon & Rambold sp. nov.
Illa ob apothecia et habitum ad *S. holophaeam* similaris sed ab hac specie thallo cum corticibus ex hyphis pachydermatis intertextisque irregulariter vel periclinaliter ordinatis, debiliter vel modice gelatinisatis, sine strato epinecrali, rhizinis vulgaribus plerumque submarginalibus e texturis corticalibus factis; apotheciis cum stipitibus longioribus, hymenio et subhymenio et cortice excipuli thallini debiliter gelatinisato, paraphysibus facile separatis, ascosporis cum apicibus acutis vel acuminatis; thallo acido lobarico continente differt.

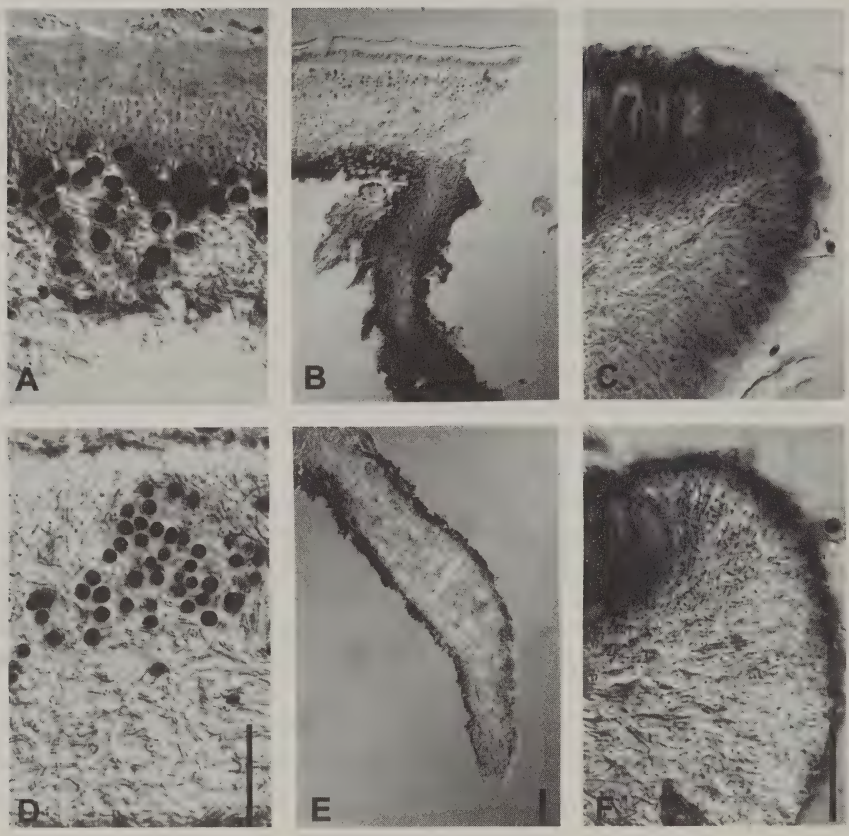


Figure 1. *S. holophaea*: A. thallus in longitudinal section (Köfaragó-Gyelnik, Lichenoth. 61, CANB); B. rhizines in longitudinal section (Vězda, L. R. Exs. 70, M); C. excipulum in longitudinal section (Köfaragó-Gyelnik, Lichenoth. 61, M). *S. elixiana* (holotype, CANB): D. thallus in longitudinal section; E. rhizines in longitudinal section. F. excipulum in longitudinal section. – Scales: 50 µm.

Type. Australia. Queensland, Mt Timbeerwah, 37 km SE of Gympie, 26°24' S, 152°59' E, 250 m. Large rock outcrop and boulders on easterly slope. On moist faces of siliceous rock which are ± covered with cyanobacterium (cf. *Gloeocapsa* etc.), 26 April 1996, *J. A. Elix 42574 & D. Verdon* (CANB–holotype, M–isotype).

Macro-morphology: *Thallus* small foliose, up to 4 cm wide, irregularly imbricately lobate; lobes rotund, broad rotund or occasionally oblong with almost truncate apices, sparsely reniform or pandurate, ± with whitish, crystalline pruina at apices, especially when young, 1–2(–2.5) mm broad, spreading to ascending, flat to slightly concave or becoming convex laterally, often arched and ± hooded when fertile, apically entire or indented to bilobed, sometimes trilobed or more; ultimate lobules 0.25–1 mm broad; margins entire or slightly crenate; upper surface greyish green or becoming whitish green, sometimes darkened with age, appearing smooth or slightly roughened and matt, but sometimes with scattered, whitish brown, minutely erect hyphal hairs; isidia and soredia absent; lower surface white, mat but covered with greyish brown ± intricately interwoven hyphal tomentum (visible at 30–40 ×, but observed best at 100–400 × magnification), rhizinate; rhizines stout, 0.3–1.5 mm long, predominantly submarginal or rarely marginal (cilioid), sometimes weakly branched. *Apothecia* laminal to submarginal, sometimes appearing marginal due to hooded fertile lobes, stipitate; disc black, or dull brownish when moistened, concave to flat or convex at maturity; thalline margin greyish white, becoming gray to dark greyish brown, moderately thick when young, soon thinning, excluded by convex disk at maturity; stipes thalline (i. e. 'pseudopodetiate'), pale greyish green, sometimes becoming whitish, 0.5–1 mm long. *Pycnidia* immersed; apex emergent, forming dark brown to black papillae or occasionally raised in whitish-green verrucaeform tissue and simulating young apothecia.

Micro-morphology: *Thallus* (100–)130–250(–280) µm thick, corticate; cortex formed of pachydermatous hyphae, irregularly or ± periclinally oriented, interwoven, weakly to moderately gelatinized; upper cortex irregularly thin above algal bundles, thicker between them, or irregularly surrounding them; medulla of interwoven pachydermatous hyphae, 2.5–5 µm diam., irregularly or ± periclinally oriented, a few hyphae becoming gelatinized especially where lower cortex formed; lower cortex poorly or irregularly developed, best developed towards margins; hyphae interwoven but periclinally oriented; tomentum 8–15(–20) µm thick, formed of interwoven, greyish brown to dark greyish brown, leptodermatous hyphal

hairs; rhizines 165–200(–250) µm thick; structure formed of cortical tissue, covered externally with the same tomentum as lower surface. *Phycobiont* chlorococcoid; cells spherical, 5–10 µm diam., often in irregular bundles. *Apothecia* 200–400 µm thick; stipes 400–800 µm diam. with moderately loose to dense medullar hyphae, sometimes partially gelatinized, with cortex as in thallus; excipulum 80–250 µm thick, corticate as in thallus but hyphae sometimes more dense; medullar zone and phycobiont as in thallus; parathecial zone inconspicuous; subhymenium weakly gelatinized, colorless or slightly yellowish cream, 50–100 µm thick, of densely interwoven hyphae. *Hymenium* weakly gelatinized, colorless or with thinly scattered slightly brown areas, I+ blue; epihymenium thin, formed of paraphysal apical cells, K– N–; paraphyses slender, not branched, very weakly conglutinated, 1–2 µm diam.; apical cells clavulate to obovate, 5–6 × 2.5–4 µm, with pale brown lumina and dark brown walls. *Asci* clavate to broadly clavate, 35–50 × 10–13 µm, (6–)8-spored, of *Catillaria*-type. *Ascospores* irregularly biseriate, ellipsoid to narrow ellipsoid, with acute to acuminate apices, 10–17 × 3.5–5 µm. *Pycnidia* globular, 170–250 µm diam.; pycnospores bacilliform, 2–3 (–4) × c. 1 µm, developed from mostly intercalary conidiogenous cells (intermediate structure between type 6 and 7 sensu VOBIS & HAWKSWORTH, 1981).

Chemistry: K –, C –, KC + fleetingly red, PD –, containing lobaric acid.

Habitat and distribution: *S. elixiana* has so far been found only at two localities. One in Queensland (Australia), an additional one in La Réunion (Mascarene Islands). The specimens collected in Queensland represent a moderately large population. At both localities, the species inhabits moist and periodically inundated, steeply sloping siliceous rock.

S. elixiana is characterized by the irregular thallus and somewhat irregularly imbricate lobes which are laterally convex when mature and fertile and more or less apically ascending when younger. The thallus as a whole has a pale green to pale greyish green upper surface, which sometimes becomes whitish green and often shows scattered microscopic greyish brown hair-like protrusions. These protrusions appear to be a stunted growth of pigmented hyphae similar to those which cover the lower surface and sometimes the margins. These lower surface hyphae are tomentum-like and are greyish brown to dark brown, thin-walled and short, they are also bent or tightly interwoven. Another important characteristic of *S. elixiana* are the rhizines, which are predominantly produced near the margins. The rhizines are

covered by pigmented hyphae the same as and continuous with those of the lower surface and are sometimes irregularly branched. In addition, the apothecia of *S. elixiana* with stipes up to 1 mm long are also characteristic of this new species and the depsidone lobaric acid, present in *S. elixiana*, has not been observed in other species of the genus.

Micro-morphologically *S. elixiana* is characterized by a cortex of moderately to weakly gelatinized (Fig. 1D), thick-walled and irregularly to periclinally oriented hyphae. Two other features of note are the presence of a layer of lobaric acid crystals in the upper cortex and the absence of an epinecral layer. The lobaric acid crystals form an irregular layer of ± dendritic clusters of straight to slightly curved needles which, although colorless, appear slightly grey in mass by contrast with the pallid cortex. Moreover, the development of an irregularly or poorly developed lower cortex, from which the rhizines are derived, is a further interesting characteristic of *S. elixiana*. As a consequence of this derivation, the internal structure of these rhizines is formed of gelatinized, irregularly oriented thick-walled hyphae which are not pigmented (Fig. 1E). In addition, the ascospores, with acute to acuminate apices that give the narrowest spores an almost fusiform appearance, are also quite characteristic for *S. elixiana.*

There are no species of *Solenopsora* known to the authors with a similar combination of macro- and micro-morphological, chemical and ecological characters as realized in *S. elixiana*. The frequently collected *S. holophaea* is, according to the knowledge of the authors, the only known among the dozen of species with rhizines present or their presence being mentioned in the original description. A comparison with this species therefore seems appropriate. *S. holophaea* is also characterized by a small-foliose habit and has irregularly imbricate thallus lobes. However, the mature lobes are flat to concave and often deeply so when young (although rarely distorted and then irregularly convex) and the upper surface is initially olivaceous, but very often becomes brown. The lower surface of this species is also covered with greyish brown to dark brown pigmented hyphae as in *S. elixiana.* In *S. holophaea*, however, they do not form a tomentum but are more or less straight, longer and often appressed. Occasionally, these hyphae increase in number and from them large, irregular and more or less branched rhizines are formed. This phenomenon, however, is observed only on older lobes which are near to or are in contact with the substrate. The apothecia of both, *S. holophaea* and *S. elixiana*, are more or less stipitate but in *S. holophaea* they are usually sessile to substipitate and the stipes are never as long (i. e.

to 1 mm) as of those in *S. elixiana.* The ascospores of both species are uniseptate, but the acute to acuminate apices of the spores of *S. elixiana* distinguish them from those of *S. holophaea*, which have obtuse to broadly obtuse apices.

In marked contrast to *S. elixiana, S. holophaea* is characterized micro-morphologically by a cortex of strongly gelatinized thin-walled hyphae with enlarged cells. Unlike those in *S. elixiana*, these hyphae are predominantly anticlinal in orientation and above them is a significant epinecral layer (Fig. 1A). Furthermore, no crystallized extra-cellular substance has been observed in the cortex of *S. holophaea* and no lower cortex is present in this species. In addition, the increased mass of pigmented hyphae mentioned above can be seen micro-morphologically to be periclinal in orientation and to appear almost cortex-like. The internal structural hyphae of the rhizines in *S. holophaea* differ significantly from those in *S. elixiana*, even though the rhizines appear superficially similar. In *S. holophaea* these structural hyphae are not loosely irregular, but vertically densely packed and not gelatinized . They are also greyish brown to dark brown (Fig. 1B) as the pigmented hyphae from which they are derived. Both species can be distinguished also chemically by the content of lobaric acid in *S. elixiana* and of two unidentified substances (in TLC), probably terpenoids, in *S. holophaea.*

In conclusion, similarities in the macro- and micro-morphology of the thalli and apothecia of *S. holophaea* and *S. elixiana* (Fig. 1C, F) suggest that there is a close relationship between these two species, but the relative distance between them is difficult to determine without molecular data. It does, however, seem clear, given the morphological similarities, that *S. elixiana* is closer to *S. holophaea* than to other species in the genus but is still well delimited from it.

Acknowledgements

The epithet of this new species honors J. A. Elix (Dept. of Chemistry, Australian National University, Canberra), renowned for his immense contribution to lichen chemistry and taxonomy of Australasian lichens. We are grateful to E. Timdal (Oslo) for kindly supplying us with an additional specimen of the new species and for helpful comments on the manuscript. Thanks are also due to P.M. McCarthy for advice and discussion, to H. Streimann and J. Curnow (all Canberra) for kindly facilitating literature searches and to the curators of CANB, M, and O for the loan of specimens.

Additional specimens examined

Solenopsora candicans: GERMANY: Bayern: Oberfranken, an Dolomitfelsen der Kemitzen-Steine westlich von Weis[s]main im Frankenjura, 4 September 1887, *F. Arnold* (M, Arnold, Lich. Exs. 1221 – sub *Ricasolia candicans*). FRANCE: Artois, Dept. Pas-de-Calais: Audresselles, cran aux oeufs falaise maritime sur rochers arénacés face à la mer, April 1983, *E. Sérusiaux 4733* (CANB).

Solenopsora elixiana: AUSTRALIA: Queensland: Mt Timbeerwah, 37 km SE of Gympie, 26°24' S, 152°59' E, 250 m alt, large rock outcrop and boulders on easterly facing slope, on moist sandstone rocks ± covered with cyanobacterium (cf. *Gloeocapsa* etc.), 4 September 1993, *J.A. Elix 35549* (CANB). MASCARENE ISLANDS: La Réunion: Cirque de Cilaos, Basin de Salazes, where the road crosses Ravine Pissa, 21°06'S, 55°27'E, 1190 m, steep, SW-facing, exposed, periodically inundated rock close to stream, 10 February 1996, *H. Krog & E. Timdal RE33/08* (O, M).

Solenopsora holophaea: GREAT BRITAIN: North Devon: Lynton, Lee Bay, große Blöcke und Felsen am Fuße der Steilküste, 3 September 1971, *H. Hertel 12375* (M). FRANCE: Bretagne: Loire-Atlantique, Piriac (Loire-Inférieure), 'ad terram et arenas inter saxa maritima', August 1936, *H. des Abbayes* (M, des Abbayes, Lich. Gall. Exs. 38 – sub *Candelariella holophaea*). PORTUGAL: Dist. Beja: Ponte do Lima, Vale de Pereiras (muros), September 1917, *G. Sampaio* (M, Sampaio, Lich. Portugal 143 – sub *Solenopsora holophaea*); Dist. Evora: Alto Alentejo, prope Évora, ad cementum in fissuris muri septentrionem spectantis, 300 m, 19 May 1957, *C.N. Tavares* (M, Tavares, Lich. Lusitaniae Sel. Exs. 115 – sub *Solenopsora holophaea*). CAPE VERDE ISLANDS: Santo Antao: Bando de Ferro, zwischen Rib. Grande und Rib. da Torre, auf Gestein und über Spaltenfeinerde, 1280 m, 2 Oktober 1988, *B. Mies 998j* (M). SPAIN: Canary Islands: Gran Canaria, Dist. Mogán, in declivibus occidentalibus montis Guirre supra urbem Mogán, ad terram in fissuris rupium basalticarum, 500–600 m, 15 February 1993, *A. Vězda* (CANB, Vězda, Lich. Rar. Exs. 70 – sub *S. holophaea*); Dist. Moya, Loma del Bermejal, 980 m, 14 March 1983, *T. Feuerer & N. Höhne* s. n. (M); Teneriffa: Puerto de la Crux, in lehmigen Ritzen der Küstenfelsen, 5 June 1959, *O. Klement 7539* (M). ITALY: Liguria: Province Genova, 'prope Genuam (Voltri)', *A. Massalongo 334* (M, isotype of *Solenopsora requienii* A. Massal.); Liguria occidentalis, Arenzano, ad ripam, 26 December 1934, *C. Sbarbaro* (M, Köfaragó-Gyelnik, Lichenoth. 61 – sub *Solenopsora requenii*); Sardinia: Distr. Cagliari, reservatum nature 'Monte Arcosu', ad latera montis 'Lattias', 950 m, in fissurium rupium silicearum, 30 August 1989, *P.L. Nimis, C. Roux, M. Tretiach & A. Vězda* (M, Vězda, Lich. Sel. Exs. 2369 – sub *Solenopsora holophaea*).

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SOUTH AFRICAN FUNGI 7: TRICHOLOSPORUM LAETEVIOLACEUM SP. NOV., A REPRESENTATIVE OF A GENUS NEW TO SOUTHERN AFRICA.

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An account of the genus *Tricholosporum* Guzmán is given and its relationship with *Asproinocybe* R. Heim is discussed. A new taxon *Tricholosporum laeteviolaceum* sp. nov. is described based on a South African collection from the province of Gauteng.

Key words: *Tricholosporum, T. laeteviolaceum, Asproinocybe*, South Africa

Introduction

The discovery of this beautiful Tricholomatoid fungus under indigenous vegetation on the banks of the Pienaars River, at Hammanskraal, North of Pretoria is of special interest, since it is the first report of a representative of the genus *Tricholosporum* Guzmán from subsaharan Africa.

The genus *Tricholosporum* is represented in Europe by the widespread, but uncommon, *T. goniospermum* (Brés.) Guzmán ex T.J. Baroni, in Japan by *T. porphyrophyllum* (S. Imai) Guzmán ex T.J. Baroni, in USA by *T. atroviolaceum* (Murrill) T.J. Baroni and *T. pseudosordidum* (Sing.) T.J. Baroni, and in Mexico and Costa Rica by a cluster of species: *T. subporphyrophyllum* Guzmán, *T. longicystidiosum* Guzmán, *T. tropicalis* Guzmán *et al. T. violaceum* Halling & Franco-Mol. and also by *T. pseudosordidum.*

Tricholosporum was described by Guzmán (1975) to accommodate those tricholomatoid fungi with purplish or violaceous tints, at least in the lamellae, in combination with highly characteristic goniosporus, cruciate or staurosporus spores. The genus may be characterised as follows:

Sporophores terrestrial, tricholomatoid, medium to large. **Pileus** up to 160 mm diam. (*T. longicystidiosum*), dry to subviscid, glabrous, pinkish brown, vinaceous

brown, violaceous brown or bright violet. **Lamellae** adnate or sinuate to emarginate or almost free with lilaceous or pinkish tints. **Stipe** sometimes massive, up to 130 mm high, 50 mm wide (*T. longicystidiosum*), glabrous, fibrillose, often with vinaceous tints. **Spore print** white. **Spores** thin-walled, hyaline, inamyloid, goniosporus, cruciate or staurosporus. **Basidia** usually 4-spored, clavate to subcylindric, with guttulate contents, but without siderophilous granules. **Pleurocystidia** present or absent, when present thin-walled with homogenous contents, hyaline or appearing lilac in KOH and Ammonia, either subcylindric or fusiform, gradually tapering to a prolonged, narrow apex, or at the apex rather abruptly rostrate or mucronate; in some species the pleurocystidia have a rather sinuous or subvermiform appearance and resemble gloeocystidia, scarcely projecting beyond the hymenium. **Cheilocystidia** when present resembling the pleurocystidia but smaller, often rather inconspicuous. **Pileipellis** of repent hyphae which may be gelatinized or nongelatinized. Pileal context of thin-walled, hyaline inflated hyphae; pale yellow or pale yellowish brown oleiferous hyphae sometimes present. **Lamellar trama** regular to subregular, hyphae similar to those of pileal context, including the presence of oleiferous hyphae in some species. **Subhymenium** poorly defined, narrow, of densely interwoven, thin-walled, narrow hyphae. All hyphae inamyloid and with clamp connexions.
Type species: *Tricholosporum goniospermum* Bres.

At the time Guzmán published his new genus *Tricholosporum*, Singer (1975), had placed the species then known to him in *Tricholoma* section *Iorigida* typified by *T. pseudosordidum* Sing. Later (Singer, 1986) he listed *Tricholosporum* as a synonym of *Tricholoma,* and at the same time he assigned to the section *Iorigida,* in addition to *T. pseudosordidum; T. goniospermum; T. porphyrophyllum* and "apparently also *Tricholosporum subporphyrophyllum* Guzmán and *Gymnopus atroviolaceus* Murrill"

Bon (1984) also initially considered *Tricholosporum* as a synonym of *Tricholoma* "sous-section *Iorigida* Sing", but later (Bon & Braiotta, 1989) considered *Tricholosporum* at subgeneric rank, under *Tricholoma*. However, T.J. Baroni (1982) accepted *Tricholosporum* as a fully independent genus.

The genus was subsequently discussed in publications by Mora & Guzmán (1983), Guzmán, Montoya & Bandala (1990), Guzmán, Bandala & Montoya (1994), where several new species were described.

The Mexican mycologists Guzmán, Montoya & Bandala (1990) considered *Tricholosporum* to be closely related to the genus *Asproinocybe* R. Heim, which was placed by Singer (1986) in the tribe *Tricholomateae* of the *Tricholomataceae*, *Tricholosporum* also belongs to this family.

Asproinocybe is a small genus of 3 species restricted to the Central African Republic and Zaire. These species like those of *Tricholosporum* exhibit purplish or lilac tints on the basidiome. However, while species of *Tricholosporum* have cruciate or staurosporus spores, those of *Asproinocybe* are strongly tuberculate and reminiscent of those produced by some of the goniosporus species of *Inocybe*. Further, species of *Asproinocybe* were said usually, to produce milk from the lamellae, and to have laticiferous (or oleiferous) hyphae in the trama (Heinemann & Thoen, 1977), species of *Tricholosporum* were said to "probably" lack laticiferous hyphae (Guzmán, Montoya

& Bandala, 1990), although Guzmán, Bandala & Montoya (1994) reported occasional oleifers in the trama of *T. pseudosordidum* and frequent oleiferous hyphae in the trama of *T. porphyrophyllum*.

Tricholosporum laeteviolaceum D.A. Reid, Eicker, Clémençon & Cec. Roux Figs. 1 - 16

Sporophora robusta, tricholomatoidea, omnino laete violacea. Pileus 60-130 mm diam., applanatus dein in centro saepe depressus, margine leviter incurvato et nonstriato, laevis et fere nitens. Pileus in vetustate ad centrum ochrascens, ceterum pallide bubalino-decoloratus, margine laete violaceo excepto. Lamellae 6 mm altae, probabiliter stipiti sinuate affixae. Stipes 50-80 mm altus, 11-20 mm latus, plus minusve cylindricus, laevis. Caro alba, in pileo mollis, in stipite fibrillosa. Odor fungoideus. Pleurocystidia 33.0 - 57.0 x 4.0 - 6.2 μm ad basim mensa, abundantia, fusoidea vel interdum vermiformia, tenuiter tunicata, e basi gradatim angustata, ab hymenio vix emergentia. Cheilocystidia pleurocystidiis similia vel breviora 20.0 - 38.0 x 4.0 - 6.0 μm. Basidia 18.0 - 29.0 x 6.5 - 8.0 μm, clavata, hyalina, (tri- vel) quadrispora, tenuiter tunicata, contentis conspicue guttulatis. Sporae 6.2 - 8.5 x 6.0 - 7.0 μm, cruciformes vel stauriformes, tenuiter tunicatae, hyalinae, nonamyloideae, et apiculo unguiformi. Trama lamellarum regularis, ex hyphis nonamyloideis, tenuiter tunicatis, hyalinis, septatis, fibulatis, usque 4.5 - 15 μm diam. composita; subhymenia angustissima, indistincte formata, ex hyphis angustissimis, intertextis, hyalinis, fibulatis, usque 2 μm diam. composita. Caro pilei ex hyphis nonamyloideis, tenuiter tuncatis, hyalinis, septatis, fibulatis, 4.4 - 23.1 μm diam. composita. Caro stipitis hyphis nonamyloideis, parallelis, tenuiter tunicatis, hyalinis, fibulatis, 3.3 - 13μm diam., sed hyphis superficiaribus angustioribus, 2.5 - 3.5 μm diam.

Super terram subter arboribus et fruticibus indigenis *(Rhus lancea* etc.). Hammanskraal, on banks of the Pienaars River, north of Pretoria, Cecilia Roux, 7 Feb. 1996 [HOLOTYPUS in **PRUM** No 4140; Paratypus **PREM** 55358].

Sporophores robust, tricholomatoid, externally entirely bright violet. **Pileus** 60 - 130 mm diam., applanate becoming somewhat depressed at the centre, margin slightly incurved, entirely violet but fading in age, smooth and almost shiny in mature specimens. Older pilei become ochraceous at the centre, and while the margin retains its bright violet colour, the remainer of the pileus fades to very pale beige or whitish. **Lamellae** lilac to violet, attachment uncertain, probably sinuate, up to 6 mm deep. **Stipe** 50 - 80 x 11 - 20 mm., more or less cylindric, smooth, sometimes appearing farinose at the apex due to trapped spores. **Flesh** white, soft in pileus, fibrillose in stipe. Smell mushroomy. **Pleurocystidia** 33.0 - 57.0 x 4.0 - 6.2 μm measured at the base, often abundant, fusoid-vermiform, thin-walled gradually tapered from the base to an elongated, narrow, pointed apex, scarcely projecting from the hymenium and then only to about 10 μm. These organs which are not straight and rigid, appear pale lilac in ammonia and show some similarity in appearance to gloeocystidia. The shorter pleurocystidia arise in the subhymenium at the same level as the basidia, but unlike them have homogenous contents. **Cheilocystidia** similar to pleurocystidia but smaller, 20 - 38.0 x 4.0 - 6.0 μm. **Basidia** 18.0 - 29.0 x 6.5 - 8.0 μm, clavate, thin-walled,



Fig. 1. *Tricholosporum laeteviolaceum* from a watercolour painting by Cecilia Roux, showing habit x ½.

hyaline, (3) 4-spored, with numerous guttulate contents. **Spores** 6.2 - 8.5 x 6.0 - 7.0 μm, diamond-shaped, with bluntly rounded lateral protrusions, or appearing cruciate or stellate, with almost claw-like apiculus, thin-walled, hyaline and nonamyloid. **Lamella trama** regular, of thin-walled, nonamyloid hyaline hyphae, 4.5 - 15 μm diam., with clamp-connexions at the septa; subhymenium very narrow and poorly defined, comprising densely interwoven thin-walled hyaline clamp-bearing hyphae, to 2 μm diam. **Flesh of pileus** comprising thin-walled hyaline hyphae, 4.4 - 23.1 μm diam., with clamp-connexions at the septa. **Flesh of stipe** comprising parallel, thin-walled, hyaline, nonamyloid clamp-bearing hyphae, 3.3 - 13.0 μm diam.

On the ground under indigenous trees and shrubs (*Rhus lancea*, etc) Hammanskraal, on banks of the Pienaars River, north of Pretoria, Cecilia Roux, 7 Feb. 1996. [Holotype in **PRUM** No 4140; Paratypus **PREM** 55358].]

Discussion

Of the described species of *Tricholosporum* , the new taxon *T. laeteviolaceum*, would appear to come closest to *L. longicystidiosum* Guzmán *et al.*, differing chiefly in geographical distribution and in the colour of the fruit-bodies; there may also be small microscopic differences.

With regard to geographical distribution, the fact that the collection of *T. laeteviolaceum* was growing in association with indigenous vegetation suggests it is probably a species native to South Africa, and not an introduction.

The colour of *T. laeteviolaceum* is also distinctive in being bright violet throughout, with the exception of the flesh - such that it bears a very strong resemblance to *Lepista nuda* (Bull. ex Fr.) Cooke. In contrast the pileus of *T. longicystidiosum* was described as vinaceous brown to yellowish brown. Further, whereas the pileus of *T. longicystidiosum* was said to be somewhat striate and subviscid, that of *T. laeteviolaceum* is non-striate and dry. The lamellae of *T. laeteviolaceum* are much more brightly violet than are those of *T. longicystidiosum*, which were noted as pinkish to vinaceous brown. Another macroscopic difference is that while the flesh of *T. longicystidiosum* is white throughout that of *T. laeteviolaceum* is white in the the pileus and violaceous in the stipe.

Microscopically the two taxa show close agreement. According to Guzmán et al. (1990) *T. longicystidiosum* has to be grouped with the large-spored species of the genus such as *T. goniospermum, T. porphyrophyllum* and *T. subporphyrophyllum*, but even so the spores of *T. laeteviolaceum* appear somewhat larger than those of *T. longicystidiosum*: 6.2 - 8.5 x 6.0 - 7.0 μm vs (4.0) 5.0 - 7.0 x 4.0 - 6.0 μm respectively. Pleurocystidia and cheilocystidia are similar in the two taxa in that they are strikingly elongate and prolonged into a narrow pointed apex. However, the pleurocystidia of *T. laeteviolaceum* while roughly of the same length, are perhaps slightly narrower than those of *T. longicystidiosum*: 33.0 - 57.0 x 4.0 -6.2 vs (28.0) 30.0 - 65.0 x 5.0 - 9.0 (12.0) μm repectively. However, these microscopic data need to be checked against further collections of both taxa, to confirm their diagnostic value.

Another species of *Tricholosporum* was recently described from Costa Rica by



Figs. 2-7. Fig 2. Basidium with divergent sterigmata bearing developing spores. Fig. 3. Basidia with sterigmata curving inward, causing the spores to come together in a tetrad. Fig. 4. Developing spore tetrad. Fig. 5. Sterigmata diverging, developing spores discrete, prior to spore discharge. Fig. 6. Mature spores just prior to discharge. Fig. 7. Pleurocystidium protruding slightly beyond the basidia.

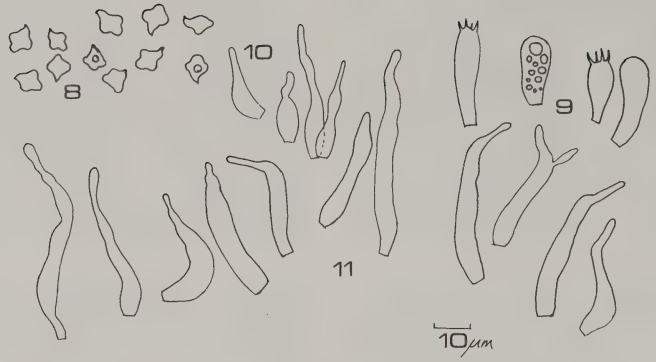
Halling and Franco-Mol (1996) as *T. violaceum* and was also compared with T. *longicystidiosum* Guzmán. *et al.* amongst others. This taxon would seem to approach our *T. laeteviolaceum* in having more violaceous pigmentation, but even so it would appear to be less brilliantly coloured than the South African fungus. The pileus of *T. violaceum* was described as grayish violet to deep violet especially at the margin, duller violet elsewhere. Further the lamellae of this taxon were said to be white with a very slight lilac tint, becoming pale brown when bruised, unlike the bright violet colour of the lamellae of *T. laeteviolaceum*. Microscopically the two taxa show close similarity, although again the pleurocystidia of *T. laeteviolaceum* appear to be more narrowly elongate and prolonged into a more narrowly tapered apex than do those of *T. violaceum*, they may also be rather narrower at the base (4.0 - 6.2 μm in *T. laeteviolaceum* vs. 7.0 - 9.0 μm in *T. violaceum*). However, it is by the spores that these two taxa can readily be separated; *T. laeteviolaceum* belongs to the group of large spored species of *Tricholosporum* with spores 6.2 - 8.5 x 6.0 - 7.0 μm whereas *T. violaceum* in contrast belongs to the small spored group of species within the genus, with spores measuring 3.6 - 5.0 x 2.8 - 4.3 μm. Halling and Franco-Mol (1996) also comment that the spores of *T. violaceum* are "rhomboid in ad-abaxial views without divaricate protuberances, narrower and often stenosporic to subtruncate at apicular end in profile". This description also applies to the spores of *T. laeteviolaceum*.

T. laeteviolaceum is also seemingly related to *T. subporphyrophyllum* from which it likewise differs in the overall bright violet colour of the basidiome, and in geographical distribution. Furthermore, *T. laeteviolaceum* is a more robust species with the pileus 60-130 mm diam, against 20 - 60 mm in *T. subporphyrophyllum*. Microscopically the chief distinction involves the pleurocystidia, which are both shorter and broader in *T. subporphyrophyllum*. In the latter they appear short, squat and lanceolate with a rostrate or mucronate apex and measure 19 - 37 (41) x (3) 5 - 15 μm, while in *T. laeteviolaceum* they are elongated, taper to a narrow pointed apex, and measure 33.0 - 57.0 x 4.0 - 6.2 μm.

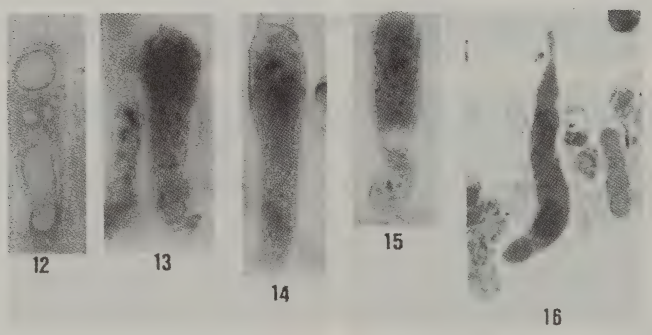
Observations in regard to spore development were made as a result of SEM studies, and various stages in this process are illustrated in Fig. 2-7.

Mature spores are basically ellipsoid to amygdaliform in shape, narrowing to an obtusely rounded apex, and terminating at the base in a claw-like apiculus. However they also develop two prominent, lateral, obtuse protuberances, which together with the less prominent boss on the adaxial side of the spore, relative to the long axis of the basidium, cause them to appear almost triangular in median section, when viewed from the pole.

Another species showing affinity with *T. laeteviolaceum* is *T. porphyrophyllum* (S. Imai) Guzmán ex T.J. Baroni from Japan. This latter taxon, although often robust has a taller, more elegant stature in contrast to the rather massive chunky or squat basidiomes of *T. laeteviolaceum*. Further the colour of the pileus of the Japanese species was described by S. Imai (1938), in his original account, as "fulvo vel subcastaneo, levi, margine pallidiori" without any indication of the bright violet colour of *T. laeteviolaceum*. Only the lamellae of *T. porphyrophyllum* were noted as having a dark purplish tint "subatropurpureus dein discolorantibus, demum fulvidus" which does not suggest the vivid colour of the lamellae of *T. laeteviolaceum*. Microscopically



Figs. 8-11. Fig. 8. Spores. Fig. 9. Basidia. Fig. 10. Cheilocystidia. Fig. 11. Pleurocystidia.



Figs. 12-16. Fig 12. Basidium in cotton blue in lactic acid showing lack of granules. Fig. 13-15. Basidia stained in iron-aceto-carmine showing stained particles. Fig. 16. Pleurocystidium stained in Eosin G, 1% water.

the Japanese and South African species are very similar, although *T. laeteviolaceum* appears to have slightly larger spores than those of *T. porphyrophyllum*: 6.2 - 8.5 x 6.0 - 7.0 μm vs. 6.0 -7.5 x 4.5 - 6.0 μm respectively.

However there is a problem with regard to whether or not *T. porphyrophyllum* and *T. laeteviolaceum* both possess pleurocystidia or wether these organs are lacking in the former taxon. Previous authors have either made no reference to the presence of pleurocystidia in *T. porphyrophyllum* (S. Imai, 1938; Ito, 1959; Hongo, 1988) or have indicated that such organs were lacking in this species (Guzmán, 1975; T.J. Baroni, 1982; Guzmán, Montoya & Bandala, 1990, Guzmán, Bandala & Montoya, 1994). It is noteworthy that the observations of Guzmán, Bandala & Montoya (l.c.) were based on a re-examination of the type material of *T. porphyrophyllum*. Nevertheless one of us (HC) has studied a Japanese collection determined as *T. porphyrophyllum* [Tagami, Minami-Kanbara-Gun, Niigata Prefecture, Japan, leg. Takahashi, 21.9.1988. In plantation of *Cryptomeria* sp.] which has pleurocystidia just like those of *T. laeteviolaceum*, except that they do not have a lilac colour in KOH - possibly due to the age of exsiccatum. Also the basidia of the Japanese fungus, unlike the South African species, usually lack granules - only a few were observed with granules, but this may also be due to age of the exsiccatum.

In order to exclude the possibility of a taxonomic relationship between *Tricholosporum laeteviolaceum* and species of *Lyophyllum* Karst., hymenial tissue of our material was subjected to iron-acetocarmine treatment by one of us (HC). This method is used to demonstrate the presence pf siderophilous granules in the basidia of *Lyophyllum* spp. These granules are a highly characteristic feature of members of the latter genus.

The cytoplasm of the basidia of (dried material of) *Tricholosporum laeteviolaceum* stains almost uniformly dark and opaque when heated in iron-acetocarmine, a method used to stain siderophilous granules (Clémençon, 1978). But the basidial contents stain in a differentiated way when the material is soaked in KOH prior to being transferred into the mordanting solution: many dark, almost black, mostly elongate to somewhat irregularly shaped inclusions become visible. They are reminiscent of the siderophilous granules of *Lyophyllum* or *Termitomyces*, but they have a distinctly different shape, and, most important, they also occur in the hyphae of the gill trama and in pre-karyogamic basidia. True siderophilous granules appear only after karyogamy and are restricted to basidia. The bodies of *Tricholosporum laeteviolaceum* do not stain at all in cotton blue, whereas true siderophilous granules do so strongly. We therefore think that these bodies are not siderophilous granules and that they do not indicate taxonomic relationship with *Lyophyllum*. This conclusion is supported by the fact that the spore wall of *Tricholosporum laeteviolaceum* is not cyanophilous, whereas the spore wall of *Lyophyllum* is strongly so.

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CHARACTERS OF FRUITBODIES, BASIDIOSPORES AND CULTURES USEFUL FOR RECOGNIZING AMYLOSTEREUM AREOLATUM AND A. CHAILLETII

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Abstract

The fruitbodies and cultures of *A. areolatum* and *A. chailletii* may be recognized by using hymenial colours, basidiospore size, colour of mycelial mat on PDA, and presence or absence of oidia in culture. Basidiospore size is just as useful a characteristic for separating fruitbodies of *A. areolatum* and *A. chailletii* as presence or absence of oidia is for cultures. Conflicting information from previous literature is discussed.

Introduction

Amylostereum areolatum (Fr.) Boidin and *A. chailletii* (Pers.:Fr.) Boidin are two fungi that have attracted much interest, both in relation to their symbiotic association with siricid woodwasps and in their own right as members of the Corticiaceae. Fruitbodies of *A. areolatum* and *A. chailletii* have generally been considered to be similar and difficult to distinguish morphologically (e.g. Skovsted, 1956; Jahn, 1971; Breitenbach & Kränzlin, 1986). However, certain characteristics of fruitbodies and cultures may aid in delimiting the species.

The basidiospore size and length/width ratio of basidiospores is considered a key character for distinguishing these species by Boidin & Lanquetin (1984). They list spore sizes of 4,8-6,5 x 2,8-3,8 µm for *A. areolatum* and 6,2-8 x 3-4 µm for *A. chailletii,* with a length/width ratio for basidiospores of *A. areolatum* less than 2, and for *A. chailletii* equal to or greater than 2. However, varying spore sizes are given in other sources.

Another trait considered important is the colour of the hymenium. *Amylostereum areolatum* fruitbodies are described as having brown-violet hymenia with purple or lilac tints, whereas the hymenial colours of *A. chailletii* are said to be grey-brown, cinnamon, nut-brown, or ochre (Jahn, 1971; Breitenbach & Kränzlin, 1986). In addi-

tion, a few sources mention the presence of a thin, dark line separating trama and tomentum in *A. areolatum* (Eriksson & Ryvarden, 1973; Jahn, 1971, 1979; Breitenbach & Kränzlin, 1986).

With respect to cultures, both *A. areolatum* and *A. chailletii* are characterized by possessing numerous clamp connections and by occurrence of encrusted cystidia after a few weeks incubation. However, the most important character is the presence of oidia in the cultures of *A. areolatum*. Because *A. chailletii* does not produce oidia in culture, this difference has long been considered the best way to differentiate cultures of these species (Siepmann & Zycha, 1968; Jahn, 1971; Stalpers, 1978; Boidin & Lanquetin, 1984). Separation of *A. areolatum* and *A. chailletii* based on the colour of mycelial mats has not been described previously.

The presence or absence of oidia in culture is helpful in distinguishing between these fungi as symbionts of siricid woodwasps. Cultures obtained from the wasps themselves or from the wood near larval tunnels can be determined from cultural characteristics alone. However, the difference applies only to the cultures. Within the intersegmental sacs (mycetangia) of woodwasps, both *A. areolatum* and *A. chailletii* produce oidia.

This article describes characteristics of fruitbodies, basidiospores and cultures useful in separating *A. areolatum* from *A. chailletii*. The aim is to compile and elaborate on characters described previously in different sources. The concept of basidiospore measurements as key character is discussed in relation to earlier works on *A. areolatum* and *A. chailletii*.

Material and methods

Fruitbodies of both *A. areolatum* and *A. chailletii* were collected from various places in Denmark, mostly within 100 km of Copenhagen. The colour of the hymenial layer was recorded, and basidiospore prints were taken on microscope slides. The prints were flooded with lactophenol (equal parts lactic acid, phenol, glycerol, and distilled water). A cover glass was added, and the combination stored for later study, as observations were not possible immediately for many of these basidiospore prints. Basidiospore measurements were made on a Reichert OPTIGRA light microscope at 10 x 63 times magnification. For each basidiospore print, 25 spores were measured, and the average length and width and the ranges were calculated. For each species a single average size and range was then calculated on basis of the measurements.

To culture from the fruitbodies small pieces of the tramal layer were removed with a sterile razor blade and placed aseptically on 4% potato-dextrose agar (PDA) or 5% malt extract agar (MEA) in 90 mm Petri dishes. After three to four weeks the colour of the mycelial mat was noted, and the presence or absence of oidia in the cultures were used to identify the isolates unequivocally as *A. areolatum* or *A. chailletii*. Colour names reported in quotations marks or with numerical codes (e.g. 6C4) are those of Kornerup & Wanscher (1981). Others are the authors vernacular. Black and white photos were made with the aid of a Nikon Optiphot with a microflex PFX attachment, in differential interference contrast at 10 x 40 magnification.

Most basidiospore measurements were made on spore prints that were several months old. Fresh spores suspended in lactophenol under cover glasses were found to drift and move slightly, thus making measurements difficult. When left for a couple of months the lactophenol dried out (albeit slowly), so that the cover glasses adhered more tightly to the microscope slides. However, measurements on three fresh spore prints of each *Amylostereum* species were also made, in order to compare the results.

Results

Only thirteen fruitbodies of *A. areolatum* were found, but in addition isolates were obtained from eleven woodwasps. All the finds were from *Picea abies* or from woodwasps inhabiting *P. abies*. Of the fruitbody finds, eight were confirmed as *A. areolatum* through the presence of oidia in culture. Spore prints were obtained from six of the fruitbodies confirmed through culturing and from two fruitbodies identified by hymenial colouring, and these prints were used for basidiospore measurements. (Table 1 & 2).

Fruitbodies of *A. chailletii* were much more abundant, occurring on *P. sitchensis*, *Larix decidua*, *Abies grandis*, *A. nordmanniana*, *A. procera*, *A. alba* and *Pseudotsuga menziesii*, but especially on *Picea abies*. Thirtythree of the fruitbodies catalogued as *A. chailletii* from fruitbody characters were positively identified through cultural characters. Of the collections identified through culturing, eight spore prints from the fruitbodies were used for measurements. (Table 1 & 2).

Hymenial colours

Amylostereum areolatum and *A. chailletii* both produce resupinate and effuso-reflexed fruitbodies. The fruitbodies used for description of hymenial colours were all confirmed as to identity through culturing and observing the presence or absence of oidia.

Most fruitbodies of *A. areolatum* had the deep brown-violet colour typical for this species on all or part of the hymenium ("ruby" 12E8 to "dark ruby" 12F7, Kornerup & Wanscher (1981)). One of the fruitbodies showed a purple to violet tinge over most of the hymenium ("deep violet" 16E8). These violet patches were also found on other fruitbodies. In addition, some parts of the fruitbodies were red-brown or paler, becoming (dark) greyish brown or even leather-brown. However, all *A. areolatum* fruitbodies could be recognized by the prevalent brown-violet colour and the quite wide, white margin around the edges. Breitenbach & Kränzlin, (1986, p 179) provide a photo showing the violet colouration of *A. areolatum*. The "deep ruby" colour resembles the photo of *Chondrostereum purpureum* (Fr.) Pouz. (ibid., p 181). Both hymenial colour types of *A. areolatum* fruitbodies may also be seen in Thomsen & Koch (1993).

The hymenial colours of *A. chailletii* are more variable than those of *A. areolatum*. They range from cream and grey ("orange grey to greyish orange" 5B2-5, Kornerup & Wanscher (1981)) over pale leather-brown (= 6C4) to "reddish-brown" (8E8) or "brick red " (7D7). However, the pale colours are most common and can be found

even on specimens where red-brown colours dominate. The margin of the fruitbody may be white, but is narrower than that of *A. areolatum*. Often, typical *A. chailletii* fruitbodies resemble *Stereum sanguinolentum* (Alb. & Schw.: Fr.) Fr. The "reddish-brown" hymenial colour may be seen in Breitenbach & Kränzlin (1986, p 181) and in Thomsen & Koch (1993), whereas the greyish colours are illustrated in Rymann & Holmåsen (1992, p 87).

Basidiospore measurement

The basidiospores from *A. areolatum* and *A. chailletii* showed a distinct difference in size. The spores of *A. areolatum* were within the range 3,6-5,6 x 2-3,2 µm, and the average spore size was 4,5 x 2,4 µm. The spores of *A. chailletii* were in the range 4,8-8 x 2,4-4 µm, and in average 6,1 x 3,1 µm wide. Thus the basidiospores of *A. areolatum* are noticably smaller that those of *A. chailletii*, and the difference can be recognized by visual observation of spore prints without measuring.

Storing the basidiospore prints caused the spores to shrink slightly. The length of the basidiospores in fresh prints did not approach the lower limits of the range seen in stored prints. Thus fresh basidiospores were never less than 4 µm long for *A. areolatum* nor 5,2 µm for *A. chailletii*. In addition, the width of fresh *A. areolatum* basidiospores stayed at or above 2,4 µm. The ranges and averages of basidiospore sizes for the two fungi is summarized in Table 1.

The length/width ratios given by Boidin & Lanquetin (1984) did not always fit for a single spore, but in average for 25 spores they were found to be precise in twelve out of sixteen cases (Table 2). In fresh sporeprints of both *Amylostereum* species the ratios held for most single basidiospores and always for the average basidiospore size. In stored sporeprints, many spores of *A. areolatum* conformed to the ratio associated with *A. chailletii*, i.e. spore length twice the width or longer. However, in average the length was less than two times the width in all cases except one (Table 2). In stored sporeprints of *A. chailletii* the average basidiospore length was generally twice the width, but some notable exceptions occured (Table 2) which is reflected in the length/width ratio for stored spores (Table 1).

Table 1 Summary of basidiospore sizes (fresh and preserved prints) for *A. areolatum* and *A. chailletii* measured in lactophenol.

	A. areolatum	*A. chailletii*
Average, fresh	4,6 x 2,6 µm	6,2 x 3,1 µm
Length/width ratio	1,77	2,00
Range, fresh	4,0-5,6 x 2,4-3,2 µm	5,2-8,0 x 2,4-4,0 µm
Average, stored	4,5 x 2,4 µm	6,1 x 3,1 µm
Length/width ratio	1,88	1,97
Range, stored	3,6-5,6 x 2,0-3,2 µm	4,8-8,0 x 2,4-4,0 µm
Boidin & Lanquetin (1984)	4,8-6,5 x 2,8-3,8 µm	6,2-8,0 x 3,0-4,0 µm

Table 2 Average and range of basidiospore size for *A. areolatum* and *A. chailletii* based on measurements of 25 basidiospores in sporeprints stored for at least 3 months. The averages marked with * do not conform to the length/width ratios given by Boidin & Lanquetin (1984). The identity of *A. areolatum* was confirmed by presence of oidia in culture except for imt 137 and 141.

Species	ID number	Average spore size	Spore size range
A. areolatum	imt 109	4,6 x 2,6 µm	4,0-5,6 x 2,4-3,2 µm
A. areolatum	imt 137	5,0 x 2,6 µm	4,0-5,6 x 2,4-3,2 µm
A. areolatum	imt 141	4,5 x 2,3 µm	3,6-5,6 x 2,0-2,8 µm
A. areolatum	imt 146	4,1 x 2,2 µm	3,6-4,8 x 2,0-2,4 µm
A. areolatum	imt 155	4,6 x 2,3 µm *	3,6-5,6 x 2,0-2,4 µm
A. areolatum	imt 156	4,5 x 2,4 µm	4,0-5,6 x 2,0-2,8 µm
A. areolatum	imt 159	4,5 x 2,3 µm	4,0-5,6 x 2,0-2,8 µm
A. areolatum	imt 162	4,4 x 2,3 µm	4,0-5,2 x 2,0-2,4 µm
Total (stored)		4,5 x 2,4 µm	3,6-5,6 x 2,0-3,2 µm
A. chailletii	imt 122	6,3 x 3,5 µm *	5,6-8,0 x 2,4-4,0 µm
A. chailletii	imt 128	6,1 x 2,9 µm	5,6-6,8 x 2,4-3,6 µm
A. chailletii	imt 138	5,9 x 3,3 µm *	5,6-6,4 x 2,8-4,0 µm
A. chailletii	imt 140	6,0 x 3,2 µm *	5,6-6,4 x 2,8-4,0 µm
A. chailletii	imt 142	5,9 x 2,7 µm	4,8-7,2 x 2,4-3,2 µm
A. chailletii	imt 144	6,1 x 2,8 µm	4,8-8,0 x 2,4-3,6 µm
A. chailletii	imt 145	6,2 x 2,8 µm	5,6-7,2 x 2,4-3,2 µm
A. chailletii	imt 163	6,2 x 3,1 µm	5,6-7,2 x 2,4-4,0 µm
Total (stored)		6,1 x 3,1 µm	4,8-8 x 2,4-4 µm

Amylostereum areolatum basidiospores were consistently smaller than *A. chailletii* - spores. *A. chailletii* spores were more variable in size, although their average length did not vary much. The average spore width of *A. chailletii* was much more variable than the average spore length (fig. 6). Single basidiospores of *A. chailletii* might approach the smaller size of *A. areolatum* spores, but in average (of 25 spores) they were always longer and wider (fig. 6). As a rule, *Amylostereum chailletii* spores are nearly always 5 µm or longer, whereas *A. areolatum* spores may be as short as 4 µm and only rarely exceed 5,6 µm in length. *Amylostereum areolatum* spores are rarely wider than 3 µm, but *A. chailletii* spores may sometimes reach 4 µm in width.

Cultural Characters

In the first cultures from fruitbodies or woodwasps grown on PDA and on MEA, the growth and colours of the mycelial mats of *A. areolatum* differed markedly from that of *A. chailletii*.

A. areolatum: Mycelial mat pellicular or very thinly felty; aerial hyphae appressed in both marginal and older parts; "yellowish brown" (5C8, Kornerup & Wanscher (1981)) to "rust brown" (6E8) or "leather brown" (6E6) with a tinge of curry-yellow

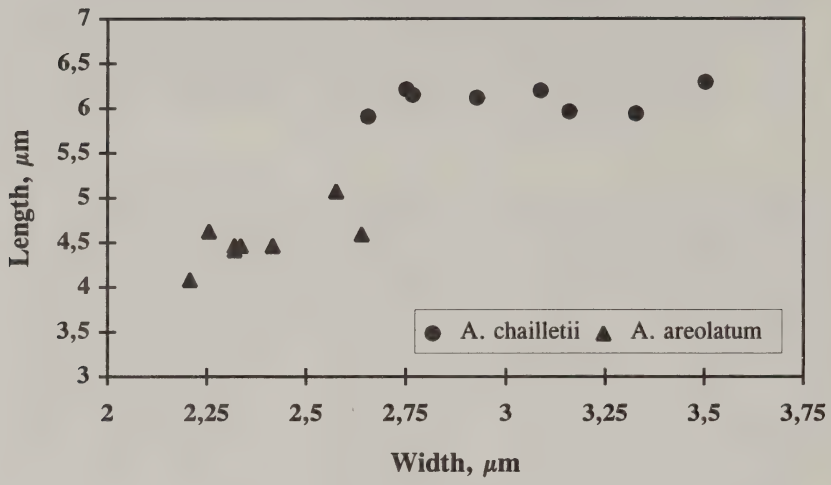


Fig. 1 Measurements of basidiospores from *Amylostereum areolatum* and *A. chailletii* in lactophenol. Each marker represents the average of 25 basidiospores from one fruitbody.

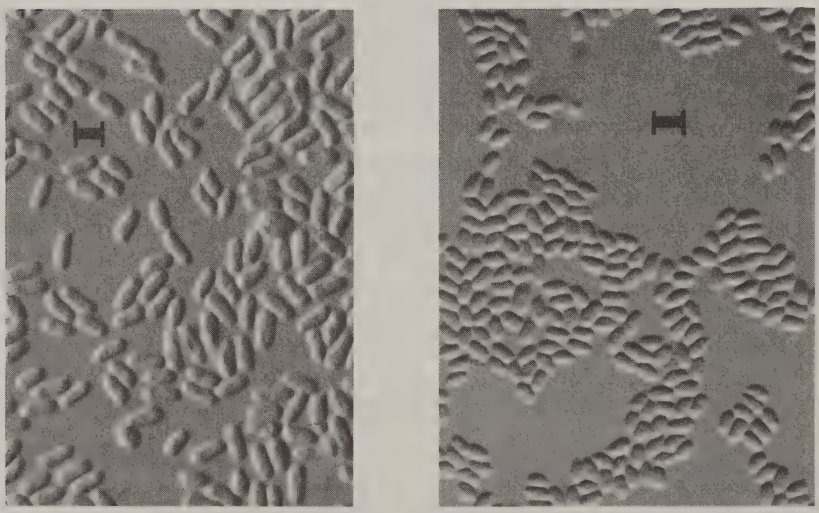


Fig. 2 Basidiospores of (left) *Amylostereum areolatum*, imt 112, and (right) *A. chailletii*, CP 1850. Bar = 5 µm. Photos J. Koch 1993.

("orange-yellow" 4B8), especially when originally isolated; reverse darkening within three weeks, especially on MEA. Sometimes changes in growth-rate and colour developed resulting in cinnamon-colour or cream-colour patches with slightly more aerial hyphae.

A. chailletii: Mycelial mats felty or woolly with felty patches, aerial hyphae not appressed in older parts but somewhat appressed in margin; cream coloured, "pale yellow" (4A3) or "yellowish white" (4A2), after 3-4 weeks with light brown specks, patches or overall tinge of "golden wheat" (4B5) or "clay" (5D5); reverse darkening slowly and in patches. The darker curry-yellow and rust brown colours typical of *A. areolatum* were never observed in *A. chailletii* isolates.

Both species are also characterized by clamps at all septa and by the appearence of encrusted cystidia after five or six weeks. Repeated transfers from *A. areolatum* isolates typically resulted in altered mat colouration, so that the colours resembled *A. chailletii*. However, the reverse colouration did not change, and small patches of the culture would retain the leather brown colour. For *A. chailletii* repeated transfers did not cause any obvious alterations.

Further descriptions of the cultural characteristics of *A. chailletii*, including colour of mycelial mat, may be found in Basham (1959), whose description was made by Nobles, and in Nakasone (1990); descriptions of cultures of *A. areolatum* may be found in Talbot (1964) and Siepmann & Zycha (1968), however none of these mention the mycelial mat colours described here. Stalpers (1978) does not distinguish between *A. areolatum* and *A. chailletii* by the colour of the mycelial mat.

Discussion

The frequency of *A. chailletii* fruitbodies found in this study showed that *A. chailletii* is correctly considered as common in coniferous forests in Denmark (Petersen & Vesterholt, 1990). The presence of *A. areolatum* (as fruitbodies) in Denmark was previously considered as probable, but records were lacking (Petersen & Vesterholt, 1990; Koch & Thongjiem, 1989). Yet the first find of *A. areolatum* as fruitbody later confirmed by the presence of oidia in culture was actually made in 1985 (Koch, deposited in the culture collection CP, Copenhagen). However, the occurence of *A. areolatum* fruitbodies was not published until 1993 with a list of finds, all deposited in CP at that time (Thomsen & Koch, 1993). Thus *A. areolatum* may now be designated as present but rare in Denmark.

Hymenial colour is a key character for distinguishing between *A. areolatum* and *A. chailletii* fruitbodies. The deep brown-violet and purple colours of *A. areolatum* are never found in *Amylostereum chailletii* specimens. For *A. chailletii* the easiest fruitbody specimens to recognize are those which look like *Stereum sanguinolentum*. Thus, the absence of a bleeding reaction on the hymenium of a *S. sanguinolentum*-like fruitbody on conifers indicates that *A. chailletii* has been found. In addition, the presence of woodwasp emergence holes near such fruitbodies also points to *Amylostereum*. Although *S. sanguinolentum* was once thought to be associated with woodwasps, this is actually not the case, even though the misconception still persists in

many places. Another common hymenial colour seen in *A. chailletii* is brick red or red-brown. In general, fruitbodies of *A. chailletii* are very variable in hymenial colour, and therefore not so easy to determine in the field.

Of the four characteristics studied, the colour of the mycelial mat in *A. areolatum* was the least trustworthy, as it changed according to the media used or with reinoculation of the cultures. However, the first culture of *A. areolatum* on PDA or MEA from a fruitbody or woodwasp usually had the typical colours. Yellow-brown or red-brown colours and pellicular or felty growth were only associated with *A. areolatum* and never with *A. chailletii*. The fast and complete darkening of the reverse side of the culture may be considered as an additional aid in identifying *A. areolatum*, as this process occurs even if the colours are not typical. Thus, the macroscopic characters described above should suggest *A. areolatum* to the observer, whether the culture was retrieved from fruitbodies, woodwasps or wood.

In contrast to *A. areolatum*, cultures of *A. chailletii* only darkened the reverse side slowly and in patches, if at all. The mycelial mats of *A. chailletii* were consistently white, cream or light brown, and the growth was much thicker. This was true of both fruitbody and woodwasp isolates. Although not as characteristic as *A. areolatum*, cultures of *A. chailletii* can at least be easily distinguished from the former, if not recognized directly. However, distinguishing unequivocally between isolates of *A. areolatum* from *A. chailletii*, whether from fruitbodies, wood or woodwasps, requires microscopic characteristics. The presence or absence of oidia is the ultimate criterion for separating *A. areolatum* and *A. chailletii*. If possible, all finds of fruitbodies considered to be either species should have the identity confirmed through culturing and checking for the oidia present in *A. areolatum*.

In addition, *A. areolatum* and *A. chailletii* fruitbodies can be accurately distinguished by the size of their respective basidiospores. As already shown in the key of *Amylostereum* species provided by Boidin & Lanquetin (1984), the basidiospores of *A. areolatum* are clearly smaller than the basidiospores of *A. chailletii*. Thus it may be recommended that sporeprints should routinely be taken of *Amylostereum* specimens collected. There is no doubt that basidiospore size can be used to identify the species just as effectively as presence or absence of oidia in culture. Compared to Boidin & Lanquetin (1984), basidiospore measurements in this study depict *A. areolatum* with smaller spores, resulting in the spore size range having lower limits (table 1). For *A. chailletii*, only the lower limits of spore lenght and width in this study differed by more than 1 µm from Boidin & Lanquetin (1984). However, it is not the exact spore size range which is most important, but the obvious and consistent difference in basidiospore size, *A. areolatum* spores being invariably smaller than *A. chailletii* spores.

An important aspect of the consistent difference in basidiospore size is that some literature concerning *A. areolatum* and *A. chailletii* should perhaps be reinterpreted. For instance, most authors agree that Pilát (1931) was mistaken in his identification of *A. chailletii* and had really described *A. areolatum*. However, the range for basidispore size given by Pilát (6-7,5 x 3-4 µm) fits *A. chailletii* rather than *A. areolatum*. In addition, the hymenial colours described by Pilát are also consistent

with those typical of *A. chailletii*. It is therefore likely that he did indeed describe *A. chailletii* and thus named it correctly.

Reinterpretations of older sources according to basidiospore measurements would also change the perception of Bourdot & Galzin (1921, 1927) and Skovsted (1956). They identified their decribed fungi as *A. areolatum*, but the basidiospore sizes given are clearly too large to fit *A. areolatum*. The range is 7-9 x 3,5-4,5 µm for Bourdot & Galzin, and 5,5-8,5 x 2,5-4 µm for Skovsted. In all of these sources the hymenial colours described for *A. areolatum* could easily be applied to *A. chailletii* instead.

In the case of Jahn (1971) an attempt at reevaluation based on basidiospore size encounters severe difficulties. In his descriptions of *A. areolatum* and *A. chailletii* Jahn (1971) was the first to place great emphasis on the dark purple-violet or blue-violet hymenial colours which are characteristic for *A. areolatum*. In addition, Jahn had some of the cultures from fruitbodies checked for the presence or absence of oidia. Based on these characteristics, Jahn undoubtedly identified the species correctly. But the ranges of basidiospore sizes were said to be 5-8,5 x 2,4-4 µm for *A. areolatum* and 5-8 x 2,5-4 µm for *A. chailletii*. In other words the spores of *A. areolatum* were considered to be as long as or longer than those of *A. chailletii*. Unless there is a printing mistake in the paper, the size of *A. areolatum* basidiospores given by Jahn seriously conflicts with both Boidin & Lanquetin (1984) and the results found in the present study. It is difficult to explain the discrepancy, especially because the average basidiospore size is not given. Thus, one possible explanation could be that a few specimens of *A. chailletii* had been classified as *A. areolatum* and not checked by culturing. Thereby the range for *A. areolatum* would come to overlap that of *A. chailletii*. This would have been revealed in the average if included, as *A. areolatum* spores would probably still have been markedly smaller than those of *A. chailletii*.

Other sources of basidiospore sizes give measurements with ranges within those described by Boidin & Lanquetin (1984) or within the results of the present paper. Examples are : Talbot (1964) 4-6,3 x 2,5-3 µm for *A. areolatum*, Eriksson & Ryvarden (1973) 6-7 x 2,5-3 µm for *A. chailletii*, Martin & Gilbertson (1980) 6-8,5 x 2-3 µm for *A. chailletii*, Breitenbach & Kränzlin (1986) 5-6 x 2,5-3 µm for *A. areolatum* and 5,5-7 x 2,5-3 µm for *A. chailletii*, and Rymann & Holmåsen (1992) 6-8 x 2,5-3 µm for *A. chailletii*.

Conclusion

It may be concluded that the four characteristics studied in this investigation are very helpful in identifying *A. areolatum* and *A. chailletii*. The presence or absence of oidia in culture and basidiospore size in fruitbodies are the best way to distinguish the two species. The advantage of basidiospore measurement is that is does not require culturing, but only access to a light microscope. Hymenial colour is useful as field characteristic, especially for *A. areolatum*. When working with isolates from wood or woodwasps, macroscopic characteristics of cultures may be helpful, although the presence or absence of oidia is infallible in making the distinction.

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LEPIOTACEAE OF FLORIDA, I. LEPIOTA S. STR., SECTION OVISPORAE

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ABSTRACT

Section *Ovisporae* (J.E. Lange) Kuhner contains species of *Lepiota* sensu stricto with ellipsoidal to ovoid basidiospores; clamp connections; and a pileipellis of long, thin pilocystidia, sometimes with an understory of much shorter, clavate elements. All of the lepiotaceous species known to contain amatoxins belong to this section. Intensive study of the Lepiotaceae of Florida has indicated the occurrence there of two species which merit placement in section *Ovisporae*: *Lepiota brevipes* Murrill and *Lepiota citrophylla* (Berk. & Broome) Sacc. This is the first report of *L. citrophylla* in Florida, and the first sectional classification of *L. brevipes*.

INTRODUCTION

The genus *Lepiota* (Pers.) Gray formerly encompassed almost all of the species now recognized within the family Lepiotaceae Roze. Advances in agaric systematics over the past century or so have led to the recognition of various segregate genera in this group, such as *Cystolepiota*

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Singer, *Chlorophyllum* Massee, *Leucoagaricus* (Locq.) Singer, *Leucocoprinus* Pat., and *Macrolepiota* Singer. The transfer of various lepiotaceous species to these more recently proposed genera has left in its wake a much narrower application of the genus name *Lepiota*. This more modern, narrower application is designated *Lepiota* s. str. in order to avoid confusion with the broader, classical concept of the genus, now referred to as *Lepiota* sensu lato. *Lepiota* s. str. contains species with thick-walled, nonporate spores which are usually not metachromatic in cresyl blue; a partial veil and often an annulus of various forms, but not pulverulent and usually not membranous; and various types of non-pulverulent pileipellis.

Various sectional treatments of *Lepiota* s. str. have been offered (Bon, 1981; Singer, 1986; Candusso and Lanzoni, 1990). The section *Ovisporae* (J.E. Lange) Kuhner, first proposed in 1936 (Kuhner), has become widely recognized. It contains those species with ellipsoidal to ovoid basidiospores; clamp connections; and a pileipellis of long, thin pilocystidia, sometimes with an understory of much shorter, clavate elements (Bon, 1981; Singer, 1986). Many of these species exhibit fibrillose to cushiony scales occurring in partial to complete bracelets on the lower portion of the stipe.

Two species of *Lepiota* s. str. in *Ovisporae* occur in Florida: *Lepiota brevipes* Murrill, and *Lepiota citrophylla* (Berk. & Broome) Sacc. This article offers morphological descriptions and illustrations of these species as they occur there. It also constitutes the first sectional placement of *L. brevipes*, and the first report of *L. citrophylla* from this state.

MATERIALS AND METHODS

Specimens of *Lepiota brevipes*, including the type and other authentic collections, were borrowed from the FLAS herbarium (University of Florida). Fresh collections were also obtained in the field. *Lepiota citrophylla* was determined from a single collection, borrowed from the SIU herbarium (Southern Illinois University at Carbondale). Herbarium abbreviations used are from Holmgren et al. (1990).

Small tissue samples were excised, wetted in 95% ethanol, then revived in water. Sections were cut by hand and mounted in 3% KOH, Melzer's reagent, and cresyl blue in aqueous solution, following standard mycological methods (Smith 1949; Largent et al. 1977; Singer 1986). Optical microscopy studies were carried out at 400 and 1000 X, and line drawings of micromorphological features were made using a Leitz drawing tube. Sketches of basidiomata were executed freehand. Size ranges of basidiospores, basidia, cheilocystidia and pileipellis were based on ocular micrometer measurements of at least 12-15 elements of each type from each collection studied. Wall thickness of the basidiospores is illustrated in only one example for each species depicted. Colors noted in descriptions are personal interpretations, followed by references in parentheses to approximately equivalent centroid colors of the ISCC-NBS illustrated color

name charts (Kelly and Judd 1965), in which the number cited is that of the color chip in the chart, and the letter sequence denotes the name of the color in abbreviated form.

RESULTS

Lepiota brevipes Murrill, J. Fla. Acad. Sci. 8: 178 (1945) Fig. 1

Macromorphological features: Pileus 1-3 cm broad, plano-convex, umbo indistinct; cuticle tomentose, dull brick orange to rusty cinnamon brown (51. deep O; 55. s. Br; 56. deep Br), intact at the disc, elsewhere disrupting into concentric, fibrillose scales; lamellae white to pale ochraceous with edges white, finely fimbriate. Stipe pallid above to brownish below, up to 2.6 cm long, equal or tapering slightly toward the apex, diameter 1.2-7 mm, with distinct zone bearing bracelet-like scales of fibrillose elements like those of the pileus cuticle, cinnamon to rusty brown, partially or rarely completely girdling the stipe, base of stipe sometimes slightly bulbous and typically bearing conspicuous, white pseudorhizomorphs; annulus poorly formed, present as a scant, white, fibrillose zone, median to supermedian, often just above and more or less connected to the uppermost bracelet-like scale.

Micromorphological features: Basidiospores 3.5-7 x 2-3.9 µm (Q = 1.59); ellipsoidal, smooth, hilar appendix small and fairly inconspicuous, wall 0.3 µm thick, germ pore none; hyaline in KOH, weakly to moderately dextrinoid, not metachromatic. Basidia 14.7-18.5 µm; clavate, tetrasterigmate; basidioles 12-15.5 x 5-7 µm, basidia and basidoles hyaline in KOH. Cheilocystidia 16-46.5 x 6.5-14 (-23) µm, clavate to slightly ventricose, often septate with pedicel of one or more elements, sometimes laterally fused, and/or with finger-like terminal element, rarely almost disarticulated; walls smooth, thin and sturdy to slightly flimsy; hyaline to slightly yellowish in KOH, abundant. Pleurocystidia lacking. Pileipellis a turf of long, thin pilocystidia up to 132 (-230) µm long, 8.1-12.8 µm wide, slightly sinuous, more or less erect, narrowly subcylindric to slightly clavate to subcapitate, apices rounded, borne on pedicels of one or more shorter elements, occasionally branched; walls sometimes thickened, internal deposits of protoplasm sometimes present and strongly meandering; hyaline in KOH; wall pigment beige to pale orange brown in KOH, deeper orange brown in Melzer's reagent. Clamp connections present and conspicuous at bases of cheilocystidia and pilocystidia, and occasionally at bases of basidia.

Collections studied: USA, FLORIDA. Alachua County, Gainesville, on ground in open high hammock, 13 Aug. 1944, *W. A. Murrill*, coll. and det., FLAS F21631 (holotype); University of Florida

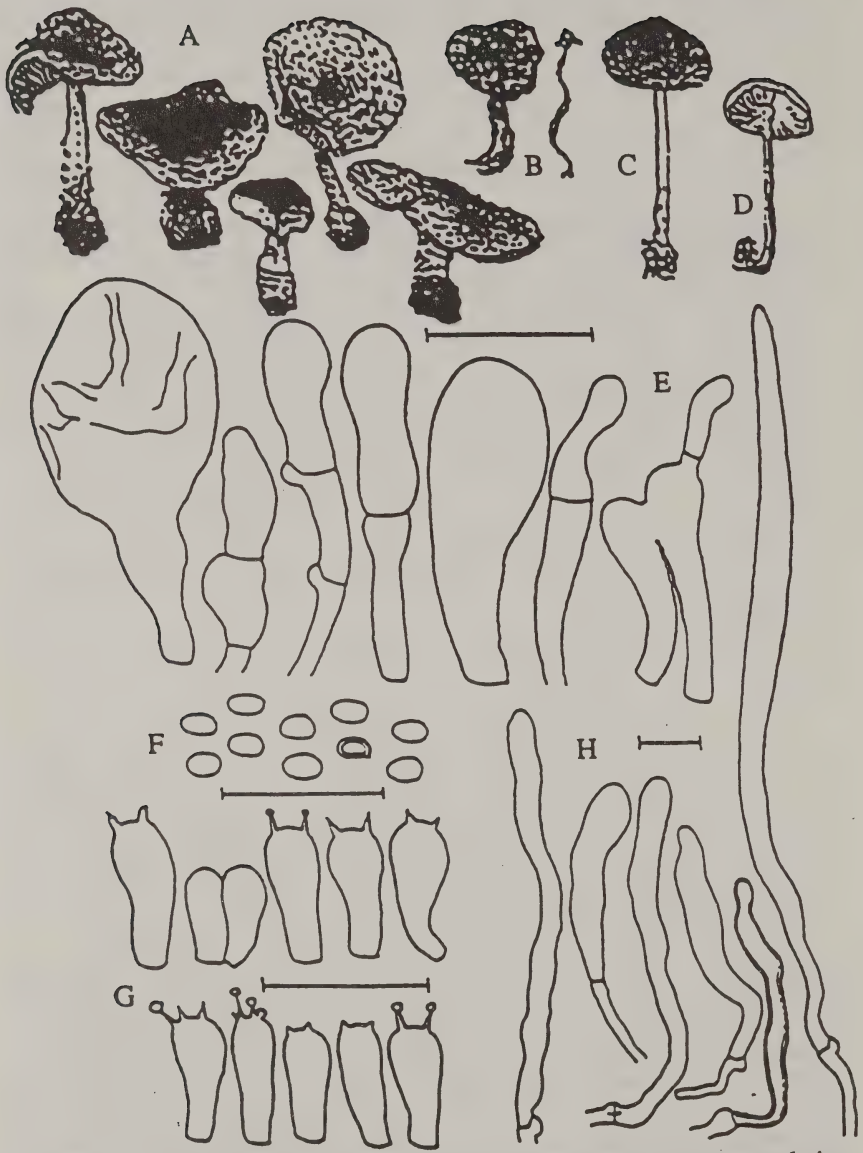


Fig. 1. *Lepiota brevipes* Murrill. A.-D. Dried basidiomata, actual size. A. FLAS F 21631 (type). B. FLAS F 18619. C. WJS VIII-11-85-3. D. BPA 92-07-02-016. E. Cheilocystidia, type (five examples at left) and BPA 92-07-02-016 (right). F. Basidiospores, type. G. Basidia and basidioles, type. H. Pileipellis, type (five examples at left) and WJS VIII-11-85-3 (right). Scale bars = 20 μm.

campus, 2 July 1949 (student collection), *W.A. Murrill*, det., FLAS F18619; near Gainesville, Austin Carey Memorial Forest, Lake Mize, 11 Aug. 1985, *W.J. Sundberg*, coll. and det., WJS VIII-11-85-3, SIU; Hague, solitary in humus under hardwoods, 2 July 1992, *B. Akers*, coll. and det., BPA 92-07-02-016, SIU; 7 Aug. 1995, *B. Akers*, coll. and det., BPA 95-08-07-009, SIU.

Comments. This is a small but otherwise typical species of section *Ovisporae*. Murrill (1945) characterized the cuticle as bay in color, and the stipe as rosy-avellaneous above and bay-scaly below. His description also mentions a farinaceous odor and taste, which has been noted for other species in this section as well, such as *L. forquignonii* Quel. and *L. echinella* Quel. & G.E. Bernard (Bon, 1981). The cheilocystidia in this species are unusual in that some of them bear an apical appendage that is separated from the main body of the cheilocystidium by a septum. In observing various degrees of this character, it appears as though at least some of the cheilocystidia may continue to proliferate after differentiation, the apical extension enlarging after its formation and then giving rise to yet another appendage. This kind of "proliferating cheilocystidium" seems quite unique among taxa investigated. The type of *L. brevipes* has been previously studied and reported on by H. V. Smith (1966). So far, this species is known only from Florida.

Lepiota citrophylla (Berk. & Broome) Sacc., Sylloge Fungorum 5: 57 (1887) Fig. 2

= *Agaricus citrophyllus* Berk. & Broome, J. Linn. Soc., Bot. 11: 509 (1871)
= *Lepiota xanthophylla* P.D. Orton, Trans. Brit. Mycol. Soc. 43: 289 (1960)

Macromorphological features: Pileus 1.2 cm broad, convex, umbo broad and slight, cuticle minutely hispid-echinate, dull buff, with scattered, fibrillose, erect squamules at and near the disc; lamellae bright yellow to pinard yellow, fimbriate. Stipe pallid, 3 cm long, equal, diameter 1 mm, base slightly bulbous; annulus scant to absent.

Micromorphological features: Basidiospores 5-8.4 x 2.9-4 µm (Q = 1.88); narrowly ellipsoidal to ovoid with apex tapering, to almost triangular with base occasionally truncate; smooth, hilar appendix fairly distinct, wall 0.4 µm thick, germ pore none; hyaline in KOH, weakly to moderately dextrinoid, not metachromatic. Basidia 20-24.4 x 6.6-7.5 µm, clavate; basidioles 15-21 x 5.9-7 µm; all hymenial cells hyaline in KOH. Cheilocystidia 13.2-34 µm, clavate, occasionally with pedicel; walls smooth, thin and sturdy to slightly flimsy; hyaline in KOH. Pleurocystidia lacking. Pileipellis of moderately long pilocystidia, up to 142 µm long and 5-17 µm wide, more or less

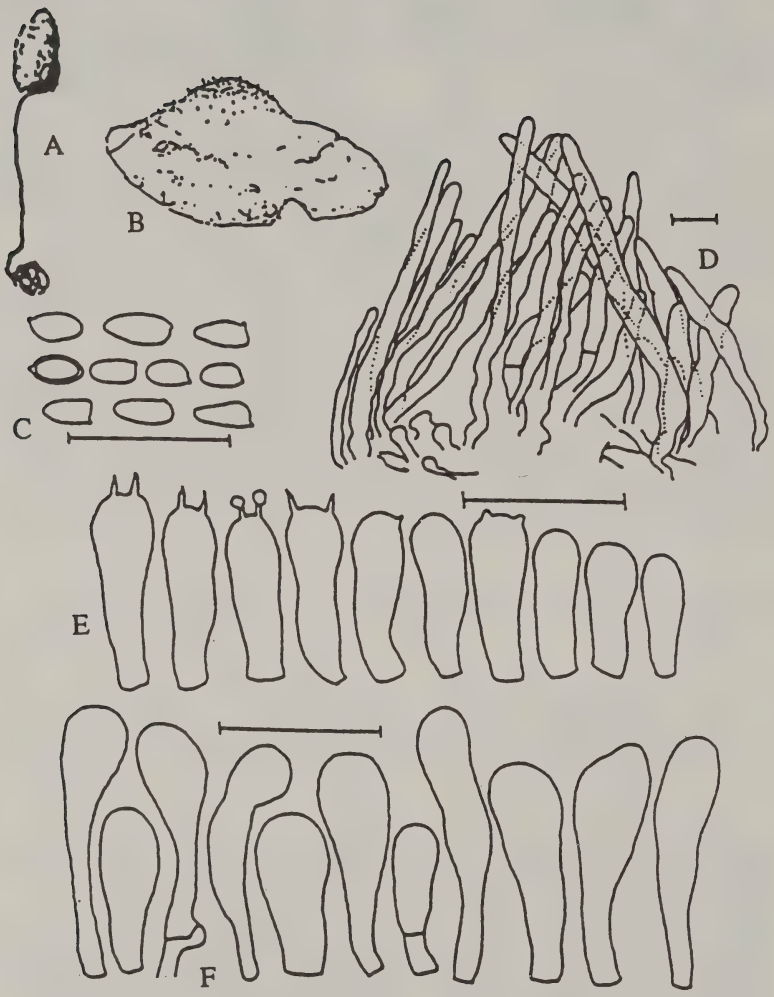


Fig. 2. *Lepiota citrophylla* (Berk. & Broome) Sacc. All illustrations WJS VIII-27-77-6. A. Dried basidioma, actual size. B. Pileus, enlarged. C. Basidiospores. D. Pileipellis, fine structure of erect squamule. E. Basidia and basidioles. F. Cheilocystidia. Scale bars = 20 μm.

straight and erect, narrowly subcylindric with apex rounded or occasionally slightly tapered or swollen, rarely septate, hyaline in KOH. Clamp connections sometimes present at bases of cheilocystidia and pilocystidia, abundant in pileus trama just below the cuticle.

Collection studied: USA, FLORIDA. Alachua Co., Gainesville, solitary, 27 Aug. 1977, *N.S. Weber*, coll. and det., WJS VIII-27-77-6 SIU.

Comments. The bright yellow lamellae of this species are unusual among lepiotaceous taxa. The basidiospores of this species are likewise unique in that they vary from typically ellipsoidal to ovoid, to occasionally truncated at the base. Basal truncation in basidiospores of Lepiotaceae is a feature usually associated with section *Stenosporae* J.E. Lange and *Lepiota cristata* (Bolton: Fr.) P. Kumm. However, most of the spores observed in this collection are ovoid, with few instances of complete basal truncation. Bon (1981) classifies this species in *Ovisporae*, subsection *Felininae* Bon, and notes the comparison with *Stenosporae*. This is a widely distributed species, but not very common. Dennis (1970) reported it from Trinidad, while Breitenbach and Kranzlin (1995) cited its occurrence in Switzerland, England, France, and Morrocco. The collection studied here is the only one known from Florida.

DISCUSSION

Section *Ovisporae* has become noted as the taxonomic repository of all the lepiotaceous species known to contain amatoxins. Fatalities have occurred in both Europe and the United States due to ingestion of *Lepiota* species in this section (Haines et al., 1985). All species classifiable in *Ovisporae* should be regarded as potentially dangerous for this reason.

The recognition here of species in this section from Florida goes to underscore a general warning that those collecting wild mushrooms as food resources should generally avoid species of *Lepiota* sensu lato, except for a few of the larger, widely distributed and well recognized species such as *Macrolepiota procera* (Scop.: Fr.) Singer. This is especially true considering that each year in Florida, the rainy season seems to bring out a small number of intrepid but poorly informed individuals in search of "magic mushrooms", who make it their practice to ingest, without adequate identification, mushrooms they find growing in pastures, against all better advisement. Cases of poisoning under these circumstances are not uncommon (J. W. Kimbrough, pers. comm.). Fortunately, no fatalities have been reported to date, and the mushroom most often implicated in such cases is *Chlorophyllum molybdites* (Meyer) Massee, another lepiotaceous species containing toxins of the gastrointestinal irritant type.

ACKNOWLEDGMENTS

The authors greatly appreciate the assistance of James W. Kimbrough, who kindly allowed our study of FLAS collections under his curatorship, and also reviewed this manuscript. Sincere thanks are also due to Gerald L. Benny for his review of this manuscript.

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AMANITA CISTETORUM AND PSATHYRELLA LICIOSAE, TWO NEW MEDITERRANEAN SPECIES

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Abstract: *Amanita cistetorum* and *Psathyrella liciosae*, two noteworthy Agaricales from southern Italy, are described as new. *Amanita cistetorum* is a greyish member of the subgenus *Vaginaria*, section *Ovigerae*, the distinctive characters of which are the subglobose spores and the structure mostly filamentous of its veil. Apparently a mycorrhizal symbiont of *Cistus*, the new species has so far been collected only in Sardinia. *Psathyrella liciosae*, a tiny, psammophilous species of the subsgenus *Psathyra*, is characterized by the spores lacking an evident germ-pore and is well distinct from the taxa of the section *Hydrophilae* by the comparatively longer spores and the peculiar cystidia the content of which is refringent when mounted in ammonium hydroxide.

Key-words: Basidiomycotina, Agaricales, *Cistus* , maquis, sand soil.

Amanita cistetorum Contu & Pacioni sp. nov.

Fig. 1

Pileo 40-100 mm, convexo haud umbonato, griseo-plumbeo dein griseo-cinereo, saepe verrucis albo-ochraceis ornato, margine striato-sulcato. Lamellis postice liberis, albis, interdum roseo-tinctis, aetate grisescentibus. Stipite 50-80x8-15 mm, base attenuato, albido vel griseo-plumbeo, omnino pruinoso-flocculoso, exannulato. Volva submembranacea, fragili, albida ochraceo-tincta. Carne sat conspicua, alba, immutabili; odore saporeque debilibus. Sporis 7.0-13.2x10.0-13.2 µm, hyalinis, in pulvere albis, monoguttatis, globosis, subglobosis vel late ellipsoideis Q 1-1.4, Qm 1.1579, haud amyloideis. Basidiis 42-56x9.5-15.2 µm, tetrasporicis, clavatis, haud fibulatis. Cellulis marginalibus clavatis vel pyriformibus, 9.5-17.5 (24)x 42-56 µm. Suprapelle pileicutis in ixocute efformata cum hyphis 1.2-7.2 µm latis, subcute ex hyphis cylindraceis, laxe intertextis, 2.4-9.6 µm latis, constituta; pigmento vacuolari. Textura veli generalis filamentosa, ex hyphis cylindraceis 2.4-12 µm latis constituta; cellulis globosis infrequentibus, hyalinis vel ochraceis, 12-55 µm latis. Oleiferis numerosis. Fibulis absentibus. Esculenta.

Habitat inter Cistos monspellienses L atque C. salviaefolios L obvia autumno. Typus: Sardinia, Sassari, Gallura, Luras loc. Diga del Liscia 26.XII.1995 leg. M. Contu (AQUI)

Ratio nominis: habitat causa.

Pileus 40-100 mm, fleshy, irregularly convex then rather expanded, always hemispherical never umbonate, lead-grey slightly viscid when young then completely ash-grey, often with velar remnants in the forms of ochraceous-whitish warts, margin striate up to 1.5 cm. Gills proportionally broad and thick, close to crowded, free, white sometimes

with a pinkish-ochraceous shade, often ash-greyish with age. Stipe 50-80x8-15 mm, short in proportion to the cap diameter, cylindric or slightly enlarged at the base, white to lead-grey, entirely covered by a colours creamy pruinosity; basal mycelium white. Annulus absent. Volva submembranaceous, fragile, scarcely sheathing that tends to remain in the soil, white with ochraceous shades evident even when young. Flesh white, unchanging, firm with a weak smell and taste. Edible.

Spore print white.

Spores 7.0-13.2x10.0-13.2 µm, hyaline, subglobose to broadly ellipsoid, few spherical, Q 1-1.4, Qm 1.157 with a central drop, inamyloid. Basidia 42-56x9.5-15.2 µm, tetrasporic, clavate or rarely utriculate, generally with granulose or oleose inclusions, without clamp connections. Subhymenium cellular. Hymenophoral trama bilateral. Marginal cells frequent, clavate to pyriform, 9.5-17 (24)x 42-56 µm. Pileipellis: suprapellis with a thick layer of ixocutis composed of hyphae 1.2-7.2 µm wide, subpellis a layer of cylindrical interwoven hyphae 2.4-9.6 µm wide, pigment vacuolar. Trama with vascular hyphae of the oleiferous type. Textura of general veil filamentous, composed of the cylindrical interwoven hyphae 2.4-12 µm wide with few single sphaerocytes,hyaline to brown, 12-55 µm wide, and oleiferous hyphae 9.5-25.5 µm wide. Clamp connections none.

Habitat: in small groups in the Mediterranean maquis, putative symbiotic of *Cistus* (*C. salviaefolius* L. and *C. monspelliensis* L.), very common in Sardinia.

Collections examined - ITALY: Sardinia Isl.; prov. Oristano, Marrubiu, Sant'Anna, *Quercus suber* L. and *Cistus monspelliensis*, 28 Nov. 1981, leg. G. Pacioni (AQUI); prov. Cagliari, Sette Fratelli, *Cistus monspelliensis*, 1 Dec. 1981, leg. G. Pacioni (AQUI); prov.

Sassari, Luras, loc. Diga del Liscia 26 Dec. 1995, leg. M. Contu (holotypus AQUI);

This species is widespread within the *Cistus* garigas of Sardinia, however, as yet it has not been gathered either in North Africa or in other Italian localities with the same habitat.

Undoubtedly, *Amanita cistetorum* belongs to the subgen. *Vaginaria* (Forq.) Quèl., section *Ovigerae* Sing., as suggested by its slightly ellipsoid, inamyloid spores, the stipe without a primordial bulb and the striate pileal margin.

Amanita mairei Foley, another very common Mediterranean species, growing on the sandy soil of coastal pine woods, appears to be close, but the latter species is readily recognised by the narrower, ellipsoid-subcylindrical spores, 11.5-13.5x7.6-9.3 µm according to Foley (1949); 10.4-13.6x8.4-9.4 µm according to Malençon & Bertault (1972) and 10-14x8-10 µm , according to Fraiture (1993).

The other greyish species known in the section *Ovigerae* , i.e. *Amanita huijsmanii* Massart & Rouzeau, *Amanita argentea* Huijsman and *Amanita conscricta* Thiers & Ammirati are also easily distinguished from the new species. *Amanita huijsmanii* is separated on the umbonate pileus, the gelatinous general veil and elliptical spores, 10.8-12x7.3-9.8 µm according to the type study by Tulloss (1994). *Amanita argentea* differs in the shiny, silver-grey cap and the elliptical spores (9.3-12x7.8-9.1 µm), again according to the type study by Tulloss (1994). Finally, *Amanita conscritta*, described from the west U.S.A., is recognised by its umbonate pileus, longer stipe, reddish veil and different spores (Thiers & Ammirati, 1982).

Understandably, in the past *Amanita cistetorum* has been mistaken for other taxa, e.g.. *A. submembranacea* (M. Bon) Groger by Pacioni &

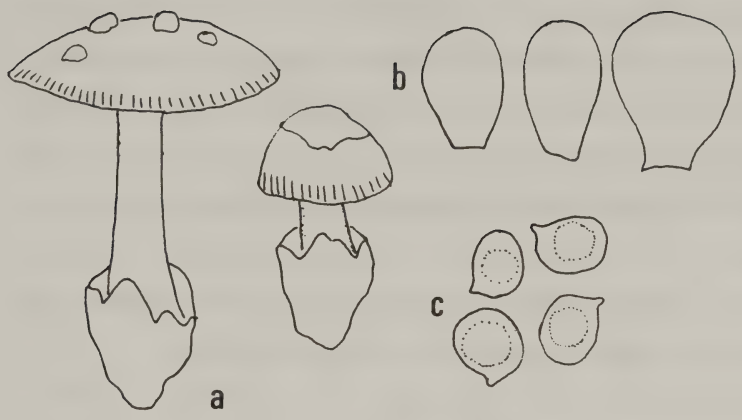


Fig. 1 - *Amanita cistetorum* Contu & Pacioni: a) sporocarps; b) marginal cells; c) spores (bar= 10 µm)

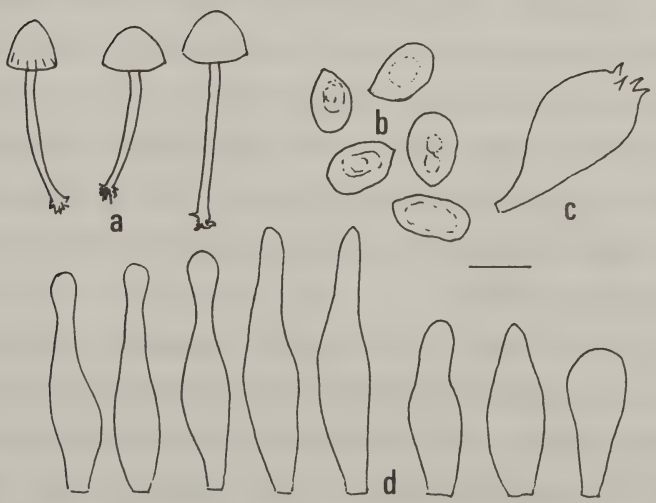


Fig. 2 - *Psathyrella liciosae* Contu & Pacioni: a) sporocarps; b) spores (bar = 8 µm); c) basidium (bar = 5µm); d) cystidia (bar = 10 µm).

Veri (1985) and *A. mairei* (Contu, 1989). For the former species, however, the subsphaerocytic structure of the veil and the olivaceous-brown cap colour re diagnostic, at least in typical forms; nevertheless, it should be born in mind that Contu (1986) recognised some greyish variants of this species as *A. submembranacea* var. *griseoargentata* Contu. At any rate, they can be recognised mainly by the shape and the veil which is grey or becomes grey, formed mainly by spherocytes, with few conspicuous filaments.

Even Contu (1989), at first, mistook *Amanita cistetorum* for *Amanita mairei.*

In our experience, *Amanita cistetorum*, not unlike other species of the subgenus *Vaginaria.* is suitable to be eaten after cooking.

Psathyrella liciosae Contu & Pacioni sp. nov.

Fig.2

Pileo 3-12 mm latu, membranaceo, convexo, numquam explanato haudque umbonato, sicco, sublaevi, hygrophano, pallide alutaceo-brunneo, dein pallide ochraceo, raro subaurantiaco, margine breviter striato, interdum floccis albis ornato. Lamellis tenuibus, strictis, haud confertis, adnexis, alutaceis dein obscurioribus sed numquam nigris, aciebus albidis, crenulatis. Stipe 8-14x0,5-1 mm, cylindraceo, basi haud incrassato, levi, albo, sericeo superne pruinato. Velo albo, fugace, in juventute tamen manifesto. Carne incospicua, pallide alutaceo-sericea; odore saporeque debilibus.

Sporis 4.4-10.0x3.8-6.0 µm, ochraceis, phaseoliformibus rare subsphaericis, poro apicalis destituitis, levibus. Basidiis 15-22x7-8 µm, tetrasporis, clavatis. Tramis lamellaribus ex cellulis largioribus, haud coloratis efformatis. Pleurocystidiis 30-45x7.5-9 µm et cheilocystidiis

30-42x7-9 µm, fusiformibus vel lageniformibus, cervice haud strangulato sed saepe subcapitato, hyalinis, tenuitunicatis, haud incrustatis. Paracystidiis clavatis vel pyriformibus. Pilei cute cellulari 22-34 µm , dermocystidiis destituta, subcute subcylindraceis cellulis presque porrectis 4-20 µm efformata. Stipite ex hyphis parallelis costituto 3.5-20 µm latis, in superficie caulocystidiis fusiformibus.
Fibulis absentibus.
Habitat gregaria sed numquam caespitosa in herbidis locis arenosis. Autumno incipiente hieme. Typus: Sardinia, Sassari, Gallura, S. Teresa di Gallura, loc. Vignola 24.12.1995, leg M. Contu (AQUI).
Ratio nominis: preclareae Liciosa Pittoru dedicata.

Pileus 3-12 mm wide, very thin, convex never fully expanded or umbonated, dry, almost smooth, hygrophanus, slightly alutaceous-brown to ochraceous, sometimes ochraceous-orange, margin striate and where young with fugacious white remnants of a filamentous veil. Gills thin, narrow, subdistant, adnexed, very pale brown (beige) to darker brown, never blackish; margin white, minutely crenate. Stipe 8-14x0.5-1 mm, cylindrical, dry, white, silky, at the apex whitish pruinose. Veil white, fugacious, reduced to floccose marginal remnants. Flesh very scarce, fragile, pale alutaceous, silky. Smell and taste weak. Spores 4.4-10.0x3.8-6.0 µm, pale ochraceous-orange in H_2O, in KOH turning first to pale violet, then soon after to pale ochraceous-brown, elliptical to phaseoliform generally the smallest sphaerical, Q 2.25-1.00, Qm 1.480, generally with a central drop, sometimes with two smaller drops, apparently without germ pore, smooth. Basidia 15-22x7-8 µm, tetrasporic clavate. Hymenophoral trama colourless, composed of subglobose elements 7-9 µm in diameter. Pleurocystidia 30-45x7.5-9 µm, fusiform or lageniform and sometimes subcapitate, thin walled,

without incrustations. Cheilocystidia of a similar shape 30-42x7-9 µm. Cystidia in NH_4OH with refringent content, 4-5 µm at base. Paracystidia clavate or pyriform 9-13.5 µm wide, with numerous transitional forms to those common among cheilocystidia. Pileipellis cellular, hyphae 22-34 µm broad, without dermatocystidia, subpellis of filamentous hyphae 4-20 µm wide almost periclinal. Stipe composed of subparallel hyphae 3.5-20 µm wide, and at stipe apex with small clusters of caulocystidia broadly fusiform 17-24x5.5-8.0 µm on sphaerocytes 6-8 m in diameter. No clamp connections and all hyphae thin walled.

Habitat: gregarious not caespitose among the grasses of coastal dunes. Autumn to early winter.

Collections examined.- ITALY: Sardinia Isl., prov. Sassari, S. Teresa di Gallura, loc. Vignola 24 Dec.1995, leg. M. Contu (holotypus AQUI); 29 Dec. 1996, leg. M. Contu (AQUI); Molise, prov. Campobasso, Campomarino, 12 Dec. 1984 (AQUI).

Owing to its pale spores, never exceeding 10 µm, and the clavate basidia, never wider than 7-8 µm, this species belongs in the subgenus *Psathyra* (Fr.) Sing. Nevertheless, its accommodation into one of its sections is rather troublesome. The occurence both of a filamentous veil and pleurocystidia and the concomitant lack of a pileus surface innately fibrillose-squamulose and of an evident germ-pore would suggest an inclusion in the section *Hydrophilae* Romagn. ex Sing. (Kits Van Waveren, 1985). However, the size and the peculiar chemical property of its spores as well as the refringent content of its cystidia in NH_4OH set it clearly apart in comparison with the other taxa of the section.

Among the species with no evident germ-pore of this subgenus, *Psathyrella liciosae* can be compared to *P. piluliformis* (Bull.:Fr.) P.D. Orton (= *P. hydrophila* ss auct. pl.) and two other related species: i.e. *P. waveneriana* Marchetti and *P. fragrans* A.H. Smith (Kits Van Waveren, 1987; Marchetti, 1993). But all these species have smaller spores, and, in addition, *Psathyrella piluliformis* also differs in its larger sporocarps , the growth in tufts on decaying stumps and the shape of the cystidia never capitulate but broadly fusiform to clavate, and *P. waveneriana* , even though sharing the same sandy habitat, has darker, never subphaseoliform spores and cystidia only fusiform, and *P. fragrans* also separates for the strong, pleasant smell, the growth in tufts on decaying conifer stumps, the polymorphic cystidia (ventricose, capitate, utriform or clavate) and the smaller spores with a minute germ-pore.

The spores of *Psathyrella maculata* (Parker) A.H. Smith, of the section *Pseudostropharia* A.H. Smith, are also without germ pore, but they are very small (4.5-5.5 µm), moreover all other characters are different.

Finally, there are a number of tiny species which might lend themselves to confusion with *Psathyrella liciosae* in the field, *P. perpusilla* Kits Van Waveren and *P. minutissima* Kits Van Waveren in particular, both, however have micromorphological characters unmistakably different.

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CALOPLACA LEWIS-SMITHII, A NEW LICHEN SPECIES FROM CONTINENTAL ANTARCTICA

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Abstract: A new muscicolous lichen species, *Caloplaca lewis-smithii* Søchting & Øvst., is described from Victoria Land, continental Antarctica. It is characterized by a grey to blackish brown microlobate thallus and a blackish apothecial disk with a white pruinose thalline margin.

Key words: Antarctica, *Caloplaca*, lichen.

Introduction

Since the study of Søchting and Øvstedal (1992) on Antarctic *Caloplaca* a substantial amount of additional knowledge has accumulated on the genus in the Antarctic region (Olech & Søchting 1993, Søchting & Olech 1995, Søchting & Olech unpubl.). About 30 species are now known from the Antarctic biome (south of 60°S). However, a recent collection of lichens from Victoria Land in continental Antarctica, by R. I. Lewis-Smith, has revealed an undescribed species that appears to be a quite common member of a characteristic lichen community on lichen-encrusted moss cushions often enriched by nutrients from nearby bird colonies. It is described here under the name *Caloplaca lewis-smithii*.

***Caloplaca lewis-smithii* Søchting & Øvst., spec. nova** (Figs. 1-2).

Thallus muscicola, microlobatus, pruinosus vel nudus. Apothecia lecanorina, nigra, margine thallino pruinoso ornatus. Sporae 14.5-15 µm longae, 7-9 µm latae, septis 4-5 µm crassis.

Type: ANTARCTICA: ROSS SECTOR, VICTORIA LAND: Harrow Peaks, 74°04' S, 164°45' E, 85 m alt., on moribund moss, 15 January 1996 *R. I. L. Smith 9867C* (AAS-holotype, C-isotype)

Thallus encrusting cushions of mossses (*Sarconeurum glaciale, Tortula princeps*), effuse, up to 2 cm diam. Consisting of *c.* 0.1 mm thick, slightly branched, short, ascending lobes or sometimes forming up to 0.3 mm broad, scattered, convex areoles; grey or blackish brown with a more or less well-developed white pruina on the surface.

Apothecia often absent, sometimes numerous and crowded, lecanorine, narrowly sessile to slightly stipitate, 0.2-0.9 mm diam. Disk slightly concave to plane, black with a faint brown tinge. Thalline excipulum *c.* 120 µm thick, initially prominent, later level with disk, concolorous with disk or grey with a ± well-developed coarse white grey pruina (Fig. 1).

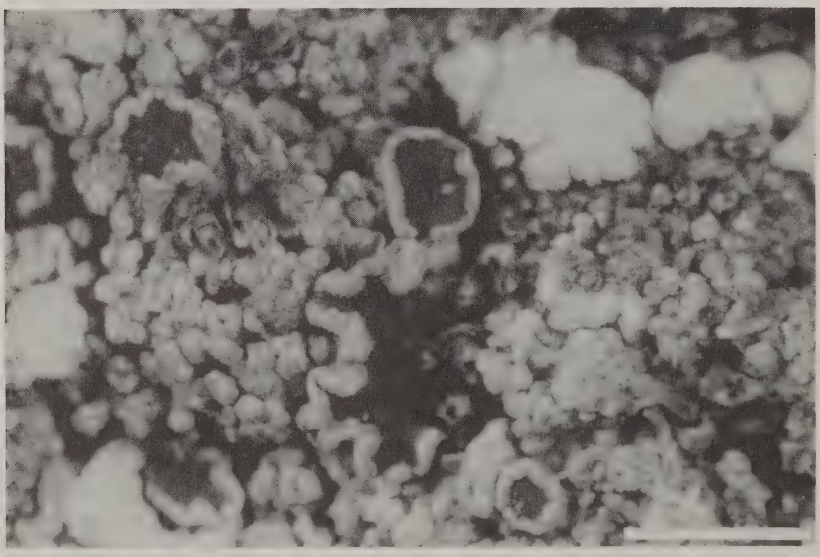


Fig. 1. *Caloplaca lewis-smithii*. Habit. R. I. L. Smith 9911. Scale 1 mm.

Thallus cortex *c.* 25 µm thick, hardly differentiated, consisting of a paraplectenchyma with more or less isolateral lumina, 3-7 µm broad. Pruina of crystals of varying size. Outer part of cortex with diffuse bluish grey to pinkish pigment covered by a 15 µm epinecral layer. Pigment K+ violet and C+ red violet.

Thalline excipulum with many algae. Cortex weakly delimited, consisting of a paraplectenchyma of isolateral, *c.* 5 µm lumina. Hypothecium with many oil droplets. Hymenium 60-70 µm high, heavily glutinized with diffuse bluish grey, sometimes pink pigment in upper 5 µm, without epipsamma. Pigment K+ violet and C+ red violet. Paraphyses *c.* 1.5 -2 µm thick, apically slightly inflated, with up to 5 µm wide apical cells (Fig. 2A). Asci with 8 spores. Spores polarilocular, 14.5-15 X 7-9 µm. Septum 4-5 µm thick (Fig. 2B).

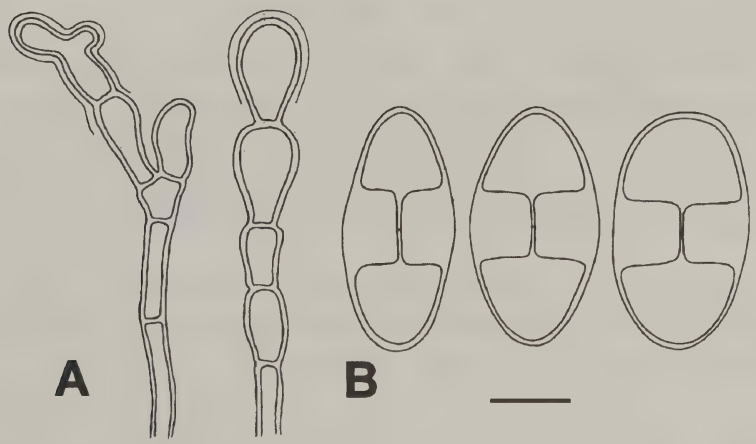


Fig. 2. *Caloplaca lewis-smithii*. A. Paraphyses; B. Spores. R. I. L. Smith 9867C (holotype). Scale 5 µm.

Chemistry: No anthraquinones revealed in thallus (R. I. L. S. 9543C) and apothecia (R. I. L. S. 9908B) with HPLC.

Etymology: Named after Ronald I. Lewis-Smith, British Antarctic Survey in appreciation of his important contributions to Antarctic ecology and biogeography and to the knowledge of Antarctic cryptogamic communities.

Discussion

Caloplaca lewis-smithii combines characters that separate it from described species within the genus *Caloplaca*. It belongs to the probably unnatural group of taxa lacking exctractable anthraquinone pigments. This group has other representatives in Antarctica (*C. austroshetlandica* (Zahlbr.) Olech & Søchting, *C. coralligera* (Hue) Søchting & Øvst.) but no pruinose, microlobate muscicolous species have been described in the group. *Caloplaca celata* Th. Fr. may be the species that it resembles most. This Arctic species grows on a range of substrates including moss (Hansen et al. 1987), but does not produce distinct thallus lobes as occur in *C. lewis-smithii*.

Ecology and Distribution

C. lewis-smithii belongs to a characteristic continental Antarctic community of lichens colonizing eutrophicated cushions of mosses growing on dry sandy and gravelly soil in sheltered habitats. Accompanying species are often *Caloplaca athallina* Darb., *C. citrina* (Hoffm.) Th. Fr. s. lat., *Lecanora expectans* Darb. and *Xanthoria mawsonii* Dodge. Such sites are usually influenced by breeding colonies of seabirds, especially snow petrels.

C. lewis-smithii is presently known only from two widely separated regions in Continental Antarctica, but as it is easily overlooked, particularly when sterile, it may eventually be shown to have a wider range.

Additional specimens examined: ANTARCTICA: ROSS SECTOR, VICTORIA LAND: Crater Cirque, 72°38' S, 169°22' E, 100 m alt., on moribund moss (*Sarconeurum glaciale*), 7 January 1996 *R. I. L. Smith 9911* (AAS), *R. I. L. Smith 9908B* (AAS), *R. I. L. Smith 9909C* (AAS) and *R. I. L. Smith 9914* (AAS); Harrow Peaks, 74°04' S, 164°45' E, 150-200 m alt., on moss (*Tortula princeps*), 12 December 1995 *R. I. L. S. 9543C* (AAS), same locality 85 m alt., on moribund moss, 15 January 1996 *R. I. L. Smith 9863B* (AAS); Kay Island 74°04' S, 165°19' E, 150 m alt., on moss, 2 January 1994 *R. I. L. Smith 9968B* (AAS, C). BYRD SECTOR, MARIE BYRD LAND: Mt. Murphy Range 75°22' S, 111°18' W, *c.* 700 m alt., on lava pavement on gentle slope, growing on soil with other lichens on moribund moss, 26 November 1990 *R. I. L. Smith 9991D* (AAS).

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INFRASPECIFIC VARIATION AMONG GEOGRAPHICALLY SEPARATED COLLECTIONS OF MARASMIUS SCORODONIUS

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Comparative morphology, mating compatibility, and extracellular laccase analyses were used to provide information on infraspecific variation within geographically separated collections of *Marasmius scorodonius*. Collections/cultures from North America and Europe were used for these analyses. Morphological analyses revealed one morphological species and mating compatibility crosses revealed almost complete intercompatibility (a single "biological species"). Electrophoretic analysis of extracellular laccase revealed four scorable bands (i.e., two distinct bands for all North American collections and two distinct but separate bands for all European collections), suggesting the beginnings of genetic divergence based on geographical isolation. Laccase results were used to analyze possible correlation with morphological and mating compatibility data.

Keywords: *Marasmius scorodonius*, Infraspecific variation, Morphology, Mating compatibility

Marasmius scorodonius (Fr.: Fr.) Fries has been reported from widely distributed geographic regions including, but not limited to, North America and Europe. Although *M. scorodonius*, a member of section Alliacei, lacks a holotype specimen, its topotype locality is in Sweden. According to Desjardin (1989), North *American M. scorodonius* is morphologically indistinguishable from Swedish material, descriptions (Fries, 1821), and water color paintings (Fries, 1862).

Previous studies have shown that *M. scorodonius* is not highly substrate-specific, with collections from North America and Europe occurring on debris of various conifers and hardwoods (Gilliam, 1976; Moser, 1983; Desjardin, 1989, 1990; Antonín, pers. com.). Studies on cultural characteristics of southern Appalachian Mountain collections revealed no significant variation in morphology (Desjardin, 1989, 1990). Based on these previous data, this species seemed to be relatively well-defined and genetically cohesive.

Our study used North American and European collections/cultures of *M. scorodonius* to: (i) provide detailed morphological analysis of collections of this taxon; (ii) employ monokaryotic cultures to test intra- and intercontinental interbreeding compatibility; (iii) utilize enzyme electrophoresis to assess enzyme profiles; and (iv) compare and correlate these data sets (morphology, mating compatibility, and enzyme profiles) to provide information on infraspecific variation within *M. scorodonius* and possible differential evolution of these characters, thereby attaining a more accurate assessment of speciation, and speciation processes, and to arrive at a more comprehensive species concept.

MATERIALS AND METHODS

Collections of basidiomata

In North America, basidiomata and cultures were harvested in areas of the southern Appalachian Mountains, concentrating on the Great Smoky Mountains National Park (GSMNP), western North Carolina and northern Georgia. Additional collecting/culturing took place in central and northeastern New York, eastern Maine and Nova Scotia.

Fieldwork was also undertaken in Europe, concentrating in areas of Sweden and Switzerland. All collections were documented and warm air-dried. Cultures were established using the techniques reported by Gordon and Petersen (1991). Collections/cultures obtained were used for mating compatibility studies, enzyme electrophoresis, and macro- and micromorphological analyses. All dried basidiomata have been deposited in the University of Tennessee Herbarium (TENN). All cultures are deposited in the University of Southern Indiana Culture Collection (USICUL).

All collections/cultures are denoted by their respective field number and when appropriate a two letter acronym indicating geographic origin (i. e., 3785 SW, field number 3785 from Sweden). The following acronyms are

used throughout to designate geographic origin: GA, Georgia; ME, Maine; NC, North Carolina; NS, Nova Scotia; NY, New York; SW, Sweden; SZ, Switzerland; and TN, Tennessee.

Table 1 lists field numbers, geographic origin, and which data sets were analyzed for each collection.

Specimens used: Canada: Nova Scotia (NS), Wolfville, Acadia University, Nature Trail, 1 Aug. 1992, Gordon, field no. 5014 (TENN 53465); Wolfville, Lumsden Dam area, 2 Aug. 1992, Gordon, field no. 5025 (TENN 53467); Kejimkujik National Park, Grafton Lake Loop Trail, 5 Aug. 1992, Gordon, field no. 5038 (TENN 53468). Sweden (SW): Gothenburg, Botanical Institute, University of Gothenburg, nature trail, 17 Sept. 1991, Gordon, field no. 3778 (TENN 50515); Västergotland, Kinnekulle Nature Preserve, 18 Sept. 1991, Gordon, field no. 3785 (TENN 50522); Myrtuvan, Trollhättan, near Jorgen Jeppson's house, 19 Sept. 1991, Gordon, Petersen, Jeppson, field no. 3796 (TENN 50533). Switzerland (SZ): Maggia Valley, Maggia, across bridge over Maggia River, 29 Sept. 1991 & 30 Sept. 1991, Gordon, & Petersen, field nos. 4749 (TENN 50346) 4754 (TENN 50351) & 4755 (TENN 50352); Ticino Valley, trail to Mt. Rema, 2 Oct. 1991, Gordon & Petersen, field no. 4772 (TENN 50369); Ticino Valley, Someo, 3 Oct. 1991, Gordon & Petersen, field no. 4780 (TENN 50377).

United States: Georgia (GA), Rabun Co., Tallulah River Area, between Coleman and Flat Branch Rivers, 15 May 1991, Gordon, field no. 2997 (TENN 50683); Maine (ME), Hancock Co., Rt. 128, Mud/Salmon Pond, 21 July 1992, Gordon, field no. 4989 (TENN 53469); Lamoine, Walter Litten property, 28 July 1992, Gordon & Litten, field no. 5005 (TENN 53474); New York (NY), Tompkins Co., Yellow Barn State Forest, 6 July 1991, Gordon & Baroni, field no. 4939 (TENN 53471); Franklin Co., Malone, Franklin Academy Nature Trail, 13 July 1992, Gordon, field no. 4969 (TENN 53466); North Carolina (NC), Macon Co., Bull Pen Road, near slick rock, 16 July 1990, R. Petersen and K. Hughes, field no. 3008 (TENN 53473); Blue Valley, Picklesimers Falls, 18 July 1991, Gordon, field no. 3701 (TENN 50689); Blue Valley, Forest Rd. 79, 17 Aug. 1992, Gordon, field no. 5046 (TENN 53470); Otto, Coweeta Hydrologic Lab, Shope Creek Rd., 19 Aug. 1992, Gordon, field no. 5067 (TENN 53472); Blue Valley, Forest rd. 79, 19 June 1992, Petersen, field no. 5137 (TENN 52670); Tennessee (TN), Cocke Co.: GSMNP, Big Creek, 16 June 1991, Gordon, Petersen, Antonín, Bhandary, field no. 3628 (TENN 50747); Blount Co., GSMNP, Elkmont, Jakes Creek, 3 July 1991, Gordon, Petersen, Desjardin, Antonín, field no. 3690 (TENN 50809); GSMNP, Crib Gap, 22 July 1991, Gordon, Desjardin, Antonín, field

Table 1. Collections of *Marasmius scorodonius* used with indication of what data sets were analysed. Check marks (√) indicate data generated. For morphological data, asteriks (*) indicate identification but no morphological data obtained.

Field No.	Location	Morphological	Mating Compatibility	Laccase Electrophoresis
2997	GA	√	√	
3008	NC	√	√	√
3628	TN	√		√
3644	TN	*	√	√
3690	TN	√	√	√
3701	NC	√	√	√
3708	TN	√	√	√
3778	SW	√	√	√
3785	SW	√	√	√
3796	SW	√	√	√
4749	SZ	√	√	√
4754	SZ	√		
4755	SZ	√		√
4772	SZ	√		√
4780	SZ	√		√
4939	NY	√	√	√
4969	NY	√	√	√
4989	ME	√	√	√
5005	ME	√		√
5014	NS	√		√
5025	NS	√	√	√
5038	NS	√	√	√
5046	NC	√		√
5067	NC	√		√
5137	NC	*	√	

no. 3708 (TENN 50696); Sevier Co., GSMNP, Greenbrier, trail to Ramsey Cascade, 20 June 1991, Gordon, Petersen, and Antonín, field no. 3644 (TENN 50763).

Morphological Analysis

Micromorphological structures were examined using techniques described by Desjardin (1989). Microscopic features examined included spore length, spore width, basidium length, basidium width, cheilocystidium length, and cheilocystidium width. Spore length/width ratios were calculated and presence or absence of clamp-connections were noted for each collection. Any unusual micromorphological features were also recorded. For each microscopic character, 25 measurements (n = 25) were recorded and treated statistically.

Mean character values were entered into the Numerical Taxonomy and Multivariate Analysis System (NTSYS-pc) version 1.70 (Rohlf, 1992). To reduce the effect of different scales of measurement, data were transformed using the linear transformation of Sokal & Sneath (1963). This linear transformation was made by subtracting the mean of i, X_i, from the raw score, X_{ij}, dividing this by the standard deviation of i, S_i, and adding a constant C ($X'_{ij} = (X_{ij} - X_i / S_i) + C$. The Average Taxonomic Distance Coefficient of Sokal and Sneath (1963) and Sneath & Sokal (1973), where $d_{ij} = \sqrt{1/n\Sigma_k (X_{ki} + X_{kj})^2}$ was then calculated for the morphological data. Data were submitted to UPGMA cluster analysis.

Cultures And Compatibility Experiments

Single-basidiospore isolates (SBIs), obtained using the protocol of techniques by Gordon (1990) and Gordon & Petersen (1991), were stored in malt agar test tube slants at 4° C. For long-term storage, the technique of Maekawa et al. (1988) was used, as well as placing agar blocks with mycelium in small vials (4 ml cap.) containing sterile water and storing at room temperature.

For enzyme electrophoresis, cultures were prepared using the technique of Gordon & Petersen (1997).

Table 2. *Marasmius scorodonius*, single basidiospore isolates (SBIs) used in intercollection matings.

Collection no.	SBI used
2997* GA	1, 2, 4, 5
4749* SZ	1, 5, 6, 9
5038* NS	1, 2, 5, 8
3008 NC	2, 4
3644 TN	2, 3
3690 TN	1, 3
3701 NC	9
3708 TN	6, 8
3778 SW	5, 11
3785 SW	1, 2
3796 SW	1, 5
4939 NY	1, 7
4969 NY	1, 2
4989 ME	1, 4
5025 NS	3, 4
5137 NC	4, 8

* Reference collections.

Determination Of Mating Systems (Self-crosses) and Selection of Tester Strains

Three collections from widely separated geographical regions were chosen as "reference collections" (Table 2). Reference collections were used for expanded intercollection crosses and as standards in morphological and electrophoretic studies. For each reference collection, a self-cross was performed to determine mating systems and mating type designations of tester strains. One tester strain representing each mating type was used for intercollection crosses. Determination of mating systems and selection of tester strains used techniques reported by Gordon (1990).

For all non-reference collections monokaryon strains were chosen randomly for use in intercollection matings (Table 2). Mating types for these isolates were unknown.

Intercollection Matings

Tester strains of putatively conspecific reference collections (four each) and ancillary collections (one - two each) were paired in all possible combinations. Table 2 lists tester strains used in intercollection pairings.

Enzyme Electrophoresis

Gel preparation, buffer solutions, electrophoresis, and staining procedures for laccase were undertaken using the protocol of Gordon & Petersen (1997). Migration of bands was measured from each well and logged as the relative mobility (R_f). Internally calibrated mobility (R_i) of each sample was calculated by dividing its relative mobility by the standard sample (reference collection) band mobility ($R_i = R_f/R_s$). Allelic designations were not assigned; rather electrophoretic bands were treated phenetically.

RESULTS

Morphological Observations

A phenogram showing morphometric relationships is given in Fig. 1. Individual collection morphometric data for each measured structure may be found in the dissertation by Gordon (1994). For the most part, morphological

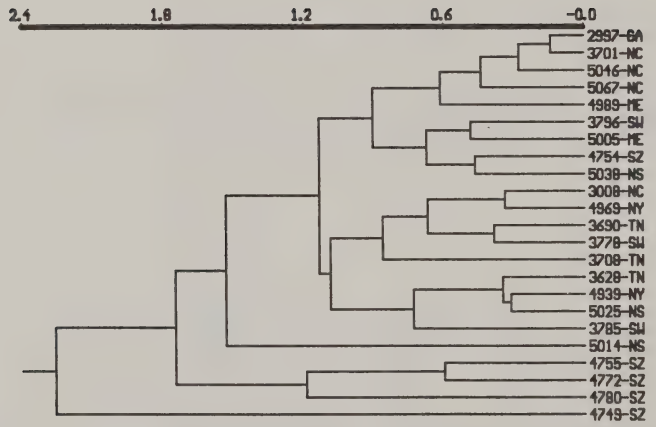


Figure 1. *Marasmius scorodonius*. UPGMA cluster analysis using micromorphological characters. Collection numbers and geographic origins are at right (see text for explanation).

comparison of 23 collections of *Marasmius scorodonius* revealed no distinct clusters which would indicate morphological divergence (Fig. 1). Data for nearly all collections fell within traditionally defined morphological species limits (see Desjardin, 1989; Gilliam, 1976, for species circumscriptions). Figure 1 illustrates that in several clusters representing morphologically similar collections, widely distributed geographic locations were included (i.e. 3796 and 5005, 3690 and 3778). Thus, while morphological variation was wide, little separation among collections could be made on geographic origins. Four collections from Switzerland (4755 SZ, 4772 SZ, 4780 SZ, and 4749 SZ) appeared to lack cheilocystidia and therefore appeared in a distinct cluster. These data are discussed in more detail below.

Self-Crosses of Reference Collections

Self-crosses of all reference collections revealed tetrapolar mating systems. An isolate marked with an asterisk (*) indicates subsequent use in intercollection crosses. Specifics follow.

No. 2997 GA - A_1B_1: 1*, 3, 11; A_1B_2: 4*, 10; A_2B_1: 5*, 9, 12; A_2B_2: 2*, 6, 7, 8. Colonies consisted of white to hyaline, submerged to appressed hyphae with little or no aerial growth. Areas around inoculum developed thick white, velvety hyphae which gave way to a light brown to yellow-brown zonate area of pigment. Compatible matings consistently produced overgrown and unreactive contact zones. Incompatible matings exhibited weak flat and barrage contact zone morphologies which aided only slightly in assignment of mating types. Cultures produced a slight odor of crushed pine needles.

No. 4749 SZ - A_1B_1: 1*, 3; A_1B_2: 5*; A_2B_1: 7, 9*, 11, 12; A_2B_2: 2, 4, 6*, 10; $A_1B_1 + A_1B_2$: 8. Hyphae around the inoculum was either white, fluffy to cottony or brown appressed and zonate. Hyphae toward the periphery of colonies was white, fluffy to cottony becoming appressed and hyaline at the plate edge. Several compatible matings (1 X 2, 1 X 4, 2 X 8, 4 X 8, 6 X 8, 8 X 9) form brown pigment submerged into the agar, which became zonate in age. Cultures emitted a faint garlic to crushed pine needle odor. Strain no. 8 was compatible with two mating types which could be a result of two incompatible nuclei being packaged in this spore or more probably two incompatible spores were harvested together during initial single-spore isolation.

No. 5038 NS - A_1B_1: 1*, 7; A_1B_2: 9; A_2B_1: 2*, 3, 6, 10; A_2B_2: 4, 8*, 11; $A_1B_2 + A_1B_1$: 5*. Hyphae around the inoculum was flat, white and thick, to flat,

brown and often zonate. This brown zone often extends several mm from inoculum. The hyphae toward the periphery of the colonies was white and flat to cottony. Compatible matings were overgrown and unreactive. Incompatible matings displayed discernable barrage morphologies but flats were inconspicuous. Mating types were designated on the basis of discernable barrage morphologies. Cultures emitted a slight garlic to crushed pine needle odor. Strain no. 5 was used in intercollection matings since strain no. 9 died during storage. Strain no. 5 had two compatible mating types present.

Intercollection Pairings

Strains of nearly all collections exhibited complete (100%) compatibility. The following collections and strains showed incompatibility: 2997:5 GA X 5038:1 NS and 4969:2 NY X 4989:1 ME. Additionally, collection and strain number 3644:3 TN was incompatible with all collections/strains except 4749: 1, 7, 9, 6, 5 SZ, 3701:9 NC, 3708:6 TN, 4989:1 ME, and 3785:1 SW. All compatible pairings typically exhibited overgrown unreactive contact zones. Incompatible matings formed weak "non-self" reactions (i.e., hyphal aggregation of one SBI and the suppression of surface hyphal growth in the other SBI) at the contact zones.

Enzyme Analysis

Laccase isozyme patterns were analyzed at four different time periods: 20, 25, 30, and 45 days. R_i values remained constant over this time period. A total of four bands were scored. A summary gel diagram, using R_i values, is given in Fig. 2. As can easily be seen, North American collections all were fixed for two bands (R_i = 0.83 and 0.89). European collections were fixed for two different bands (R_i = 0.94 and 1.0) .

DISCUSSION

Morphological data for each collection typically fell within traditionally defined morphological limits (see Desjardin, 1989; Gilliam, 1976, for complete species descriptions). Cluster analysis of morphological data indicated that collections from North America and Europe were generally intermixed. There is one cluster (Fig. 1) which shows three collections from Switzerland which clustered together. These collections (4755 SZ, 4772 SZ, and 4780 SZ) as

well as 4749 SZ were distinct in that basidiomata (2-3) from each collection lacked cheilocystidia. All other micromorphological structures analyzed were present and measurements of these structures fell within traditional morphological boundaries. While the lack of cheilocystidia in these collections could be indicative of a distinct morphological species, we do not believe that to be the case. Environmental conditions, basidiome age, and methods of preservation and storage could have resulted in the lack of, or destruction of these structures. Additionally, several other collections of *M. scorodonius* had very low numbers of cheilocystidia which were difficult to locate microscopically. Consequently, the possibility exists that cheilocystidia were present in these four collections but in low enough numbers that they escaped observation. This pattern does not seem to be a geographically or populationally related phenomenon because collection 4754 SZ (with cheilocystidia) was collected on the same day and within the same area as collections 4755 SZ and 4749 SZ (both without cheilocystidia). Collection 4749 SZ when used in intercollection matings was found to be intercompatible with all other collections.

Laccase electrophoresis showed that collections 4755 SZ, 4772 SZ, 4780 SZ, and 4749 SZ had banding patterns which were consistent with all other European collections (Fig. 2).

Mating studies showed complete intercompatibility within and between collections from North America (12 total) and Europe (4 total). Two individual intercollection matings, 2997:5 GA X 5038:1 NS and 4969:2 NY and 4989:1 ME, showed incompatibility. These two individual incompatible matings could be the result of shared mating type alleles. Additionally, collection/strain 3644: 3 TN showed reduced compatibility which could be a result of increased genetic divergence.

Only one of the collections (4749 SZ) which lacked cheilocystidia had available SBIs for mating compatibility studies. This collection was completely intercompatible with all other collections, thereby belonging to the same intersterility group. If a morphological variant of *M. scorodonius* does exist and collections of this variant are consistently intercompatible with collections from the classically defined morphological concept, then collections belonging to these two morphological groups are syngameons.

Electrophoretic analysis of laccase revealed four scorable bands for twenty-two collections. North American collections (15 total) all were fixed for two bands, one at $R_i = 0.83$ and the other at $R_i = 0.89$ (Fig. 2). European collections (7 total) were all fixed for two different bands, one at $R_i = 0.94$ and

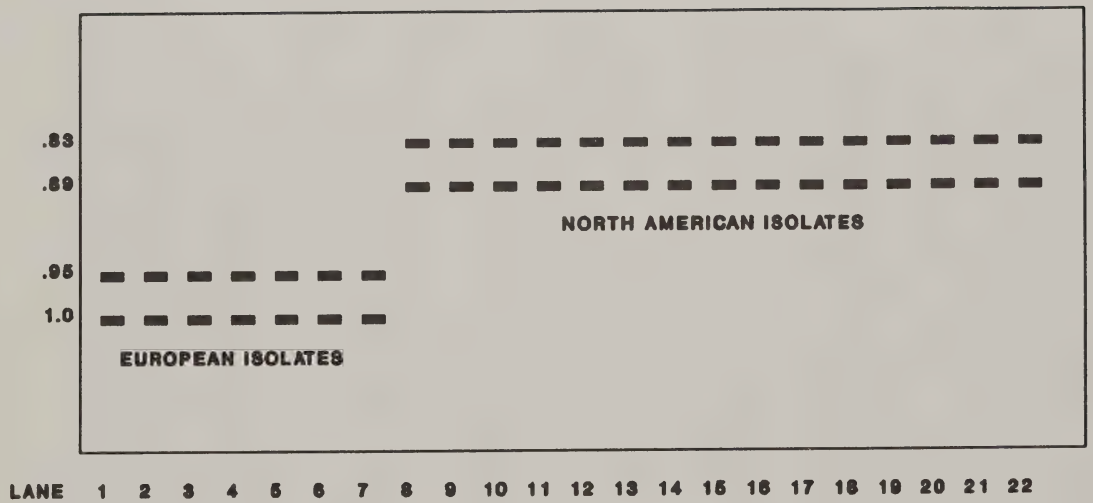


Figure 2. *Marasmius scorodonius*. Laccase zymogram based on R_f values. Lane 1, 3796 SW; 2, 4772 SZ; 3, 4749 SZ; 4, 4780 SZ; 5, 3785 SW; 6, 3778 SW; 7, 4755 SW; 8, 5046 NC; 9, 5067 NC; 10, 3701 NC; 11, 3690 TN; 12, 3708 TN; 13, 3628 TN; 14, 3644 TN; 15, 3008 NC; 16, 4969 NY; 17, 4939 NY; 18, 5038 NS; 19, 5025 NS; 20, 5014 ME; 21, 5005 ME; 22, 4989 ME

one at R_i = 1.0 (Fig. 2). In short, collections from within each continental region (sympatric) had a fixed banding pattern, and these (allopatric; Europe vs. North America) were mutually exclusive. These electrophoretic data point to isozyme genetic divergence based on geographic isolation (allopatry).

This continental electrophoretic exclusivity, in the face of virtual universal intercontinental sexual intercompatibility, strongly indicates that extremely low gene flow (or possibly none) takes place between these continents. In other words, either viable propagules do not cross the Atlantic barrier, or if they do, dikaryotization fails or the resultant dikaryons do not survive.

A further logical extrapolation is that genes controlling morphology and mating compatibility have changed (=mutated) little, because more rapid mutations would have resulted in the formation of distinct continental morphological species and/or intersterility groups.

Morphological and mating compatibility data indicate *M. scorodonius* to be relatively cohesive genetically. Although limited, laccase data seem to indicate variation which could be an indication of incipient speciation. These populations act as though they were genetically isolated (enzymes), and genetic isolation is a significant step toward speciation. These data indicate the variation of enzyme banding patterns over geography, not necessarily over morphology or mating compatibility. Therefore, caution should be taken when separating taxa based on enzyme electrophoresis (cf. Zervakis, et al., 1994).

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ZELLEROMYCES MERIDIONALIS (RUSSULALES, ELASMOMYCETACEAE), A NEW SPECIES FROM SPAIN

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Abstract. *Zelleromyces meridionalis*, a gasteroid fungus belonging to the Russulales, is proposed as a new species, giving a full description and illustrations. The main taxonomic characters are discussed and compared with related species.

Key words: *Zelleromyces meridionalis,* Russulales, taxonomy, Spain.

INTRODUCTION

The genus *Zelleromyces* was proposed by SINGER & SMITH (1960), to include those hypogeous Russulales, characterized by having astipitate basidiomata with abundant laticiferous hyphae producing latex, easy to observe when cutting in fresh. Basidiospores globose to ovoid statismosporic, orthotropic, with an amyloid ornamentation, forming a myxosporium in form of an incomplete reticulum, warty or exceptionally striate. However, this definition is not enough to separate clearly the genus from *Martellia* and *Gymnomyces*. Thus, attempts to present a practical key to differentiate the three genera (SINGER & SMITH, 1960; PEGLER & YOUNG, 1979; ZHANG & YU, 1990), have resulted somewhat confusing. BEATON & *al.* (1984) have produced a system which is, in our opinion, the most rational and the best to be followed, where *Zelleromyces* is restricted to the species with spore ornamentation reticulate or deeply ridged or winged, and laticiferous elements usually conspicuous.

Zelleromyces was based upon the type species *Z. cinnabarinus* Singer & A.H. Sm., and five other species were included in the original paper (SINGER & SMITH, 1960). Additional accounts have been done by MALENÇON (1975), PEGLER & YOUNG (1979), BEATON & *al.* (1984), TAO & *al.* (1993) and CALONGE & PEGLER (1998), raising the number of species to around fourteen worldwide. The collections studied have been deposited in Madrid (MA-Fungi) and in the senior author's herbarium (BM).

Material and methods

Microscopic observations were done using a Nikon Labophot, and 3 % KOH and Melzer's reagents. Ultramicroscopic studies were carried out as usual; samples from dried basidiomata were directly stuck onto an adhesive layer on a clean coverslip, then coated with gold and observed using a Jeol JSM-T330A SEM.

Description

Zelleromyces meridionalis Calonge, Moreno-Arroyo & Gómez, **sp. nov.** (figs. 1-2)

Etym.: *meridionalis*, belonging to the south, in this case South of Europe, Spain.

Diagnosis: Basidiomata subhipogaeus, angiocarpous, globosa, subglobosa vel irregularia, lobulata, 1-2 cm *lata, sessilis. Peridium cremeum dein rufobrunneum. Gleba concolor, loculis minutis composita. Columella nulla. Sporae globosae vel subglobosae,* 8-11 × 7-10 µm, *statismosporicae, hyalinae vel pallide brunneae, amyloideae, verrucis vel reticulato partiali instructae. Basidia* 30-40 × 12-16 µm, *inflate clavata,* 4-*sporigera. Cystidia* 30-40 × 8-12 µm, *clavata. Trama hymenophoralis heteromera, hyphis filamentosis et sphaerocystis. Subhymenium pseudoparenchymaticum. Córdoba, Cabra, subter Quercus ilex subsp. ballota,* 21-VI-1997, *coll. B. Moreno et J. Gómez. Holotypus:* MA-Fungi 38502 et BM 410.

Basidiomata subhypogeal, angiocarpous, globose to subglobose, lobed or irregular, 1-2 cm diam., sessile (fig. 1). Peridium pale cream to ochraceous, drying dark reddish brown. Gleba concolorous, made of cavities half empty, conforming a labyrinthic structure. Columella and sterile base absent (fig. 1). Spores globose to subglobose, 8-11 × 7-10 µm, including ornamentation (fig. 2), which is 0.4-0.6 µm high, statismosporic, hyaline at first, then pale brown. Myxosporium strongly amyloid, with a few free irregular warts and a partial reticulum (fig. 2). Hilar appendix 1-2 × 0.8-1.2 µm, obconical. Basidia 30-40 × 12-16 µm, inflated, clavate, hyaline to pale yellow, browning in KOH, 4-spored, rarely 2-spored, sterigmata 5-8 µm long. Cystidia cylindric to clavate, 30-40 × 8-12 µm, thin-walled, hyaline or containing granular material, scattered, difficult to observe. Hymenophoral trama 30-90 µm thick, heteromerous, composed of agglutinated hyphae, occasional laticiferous elements and scattered sphaerocysts, 10-15 µm diam. Clamp-connexions not seen. Subhymenial layer 10-25 µm broad, pseudoparenchymatous. Peridiopellis 70- 250 µm broad, composed of an epicutis, 50-60 µm thick, made of hyphal debris and amorphous material with reddish brown pigments. Peridial context, 90-180 µm thick, subhyaline,

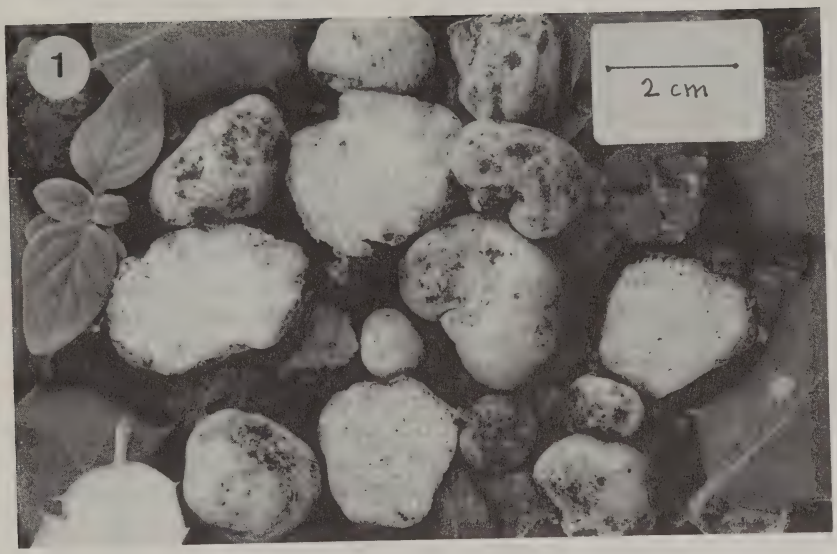


Fig. 1.–*Zelleromyces meridionalis:* group of basidiomata of different degree of development showing aspects of peridium and gleba (MA-Fungi 38502; *holotypus).*

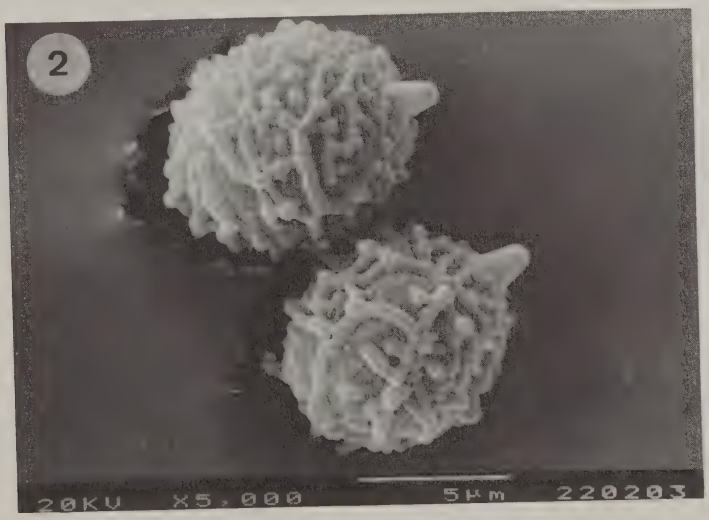


Fig. 2.–*Zelleromyces meridionalis:* basidiospores as observed in the SEM, showing the subreticulum (MA-Fungi 38502; *holotypus).*

made of thin-walled agglutinated hyphae, 3-6 µm diam., with abundant laticiferous elements, 5-10 µm diam.

Specimens examined: Córdoba, Cabra, forming colonies at about 5 cm depth, under *Quercus ilex* subsp. *ballota,* 21-VI-1997, coll. *B. Moreno & J. Gómez,* MA-Fungi 38502 *(holotypus).* Priego, Dehesilla, same habitat, 18-V-1993, coll. *J. Gómez,* MA-Fungi 32069.

Discussion

A review to the literature on the genus *Zelleromyces*, shows a close relationships between *Z. meridionalis* and several other species such as *Z. daucinus* Beaton, Pegler & Young, *Z. malaiensis* (Corner & Hawker) A.H. Sm., *Z. majus* (Cribb) A.H. Sm., *Z. josserandii* Malençon and *Z. hispanicus* Calonge & Pegler. However, they can be identified by a series of features as follows: *Z. daucinus* has a peridium carrot red when fresh, lacks cystidia, the spores show a myxosporium with a complete reticulum and it grows under *Eucalyptus. Zelleromyces malaiensis* is characterised by its longer basidia, 43-67 × 7-13 µm, peridiopellis in trichodermium, absence of sphaerocysts and ecology growing under *Eucalyptus.* Concerning *Z. majus,* it lacks cystidia, the spores are sphaerical and grows under *Eucalyptus* (Beaton & *al.,* 1984). *Zelleromyces josserandii* and *Z. hispanicus,* both produce abundant latex wen cut in fresh; and the first lacks cystidia and sphaerocysts (Malençon, 1975) and the second has broader basidiomata, 2-5 cm diam., and 2-layered peridiopellis (Calonge & Pegler, 1998).

The rest of species show quite different features. Thus, *Z. meridionalis* can be distinguished from the other described species by its subreticulate spores, pale cream peridium, presence of scattered cystidia, sphaerocysts, laticiferous hyphae and ecology, growing under *Quercus ilex* subsp. b*allota*, being proposed as a new species. Calonge & *al.* (1994), recorded *Gymnomyces ferruginascens* Singer & A.H. Sm. in Spain (MA-Fungi 32069), however, a recent revision of that material has demonstrated its identity with *Z. meridionalis.*

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PROSPODIUM TIRUMALENSIS A NEW SPECIES FROM INDIA

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The genus *Clerodendrum* L. (=*Clerodendron L.*) of the family Verbenaceae is a large genus with 400 species distributed in both tropical and sub-tropical countries of the world (Willis, 1982). From India many species of *Clerodendrum* were described by several authors:(Hooker, 1875; Gamble, 1957; Cooke, 1958; Rao & Razi, 1981).

Clerodendrum inerme (L.) Gaertn., a small shrub is commonly grown as a border plant. During a survey of the rust fungus flora of Sri Tirumala Hills, Andhra Pradesh, India, a severe rust infection was found on leaves of *C. inerme*. A critical microscopic examination of the material revealed it to be hitherto undescribed species of *Prospodium* Arth.

Prospodium tirumalensis Bagyan., Ravinder & P. Ramesh sp.nov. Fig.1-5.

Spermagoniis et aeciis ignotis. Urediniis amphigeniis, plerumque hypophyllis, circulariter aggregatis, 0.5-1.5 mm diam., aurantiacis, subepidermalibus, erumpentis, pulverulentis, epidermide ruptis conspicuis; aparaphysatis; urediniosporiis pyriformes, ellipsoideis vel oblongo-ellipsoideis, 32-55 x 20-25 (-30) µm; pariete 2µm crassis, echinulatis, poris germinationis obscuris.

Teliis hypophyllis, raro epiphyllis, circulariter aggregatis, 0.5-1 mm diam atris, subepidermalibus, erumpentis, pulvinatis, epidermide ruptis conspicuis; teliosporiis 50-75 x 24-32 µm, ellipsoideis vel cylindraceo-ellipsoideis, membrana verrucosis; mesosporae presentibus.



Prospodium tirumalensis sp. nov., Fig. 1. Infected leaves of *Clerodendrum inerme L.*, Fig. 2. Echinulate urediniospores, Fig. 3. Verrucose teliospores, Fig. 4. SEM of a single Urediniospore (2500X), Fig. 5. SEM of a single Teliospore (1500X).

Holotypus: On *Clerodendrum inerme* (L.) Gaertn. (Verbenaceae), Sri Tirumala Hills (A.P.), India, July 1986, G. Bagyanarayana, Herb. *B* (as *Puccinia tirumalensis*).

Etymology : The new *Prospodium* species is named after the place of collection, i.e., Sri Tirumala Hills, the holy abode of Lord Sri Venkateshwara Swamy of Seven hills, Andhra Pradesh, India.

Spermagonia and aecia not known. Uredinia amphigenous, circularly aggregated, 0.5-1.5 mm diam., or even more due to fusion, orange, subepidermal, erumpent, pulverulent, ruptured epidermis conspicuous; paraphyses absent; urediniospores pear shaped, ellipsoid or oblongo-ellipsoid, 32-55 x 20-25(30) µm; wall 2 µm thick, echinulate, germ pores not seen.

Telia hypophyllous, rarely epiphyllous, circularly aggregated, 0.5-1 mm diam., black, subepidermal, erumpent, pulvinate, ruptured epidermis conspicuous; teliospores 50-75 x 24-32 µm, ellipsoid, wall 3-4.5 µm thick, densely verrucose, pedicel 50 µm long, basally verrucose; mesospores present.

Sydow (1913) erected the rust taxon *Puccinia erebia* to accommodate a rust fungus parasitizing *Clerodendrum commersonii* and *C. minahassae*. The original description pertained to telial stage only. Mundkur & Thirumalachar (1946) reported the uredinial stage of *P.erebia* on *C.inerme* from India. The other authors who made a list of Fungi of India (Butler & Bisby, 1960; Rangaswamy etal, 1971; Bilgrami etal., 1991) cited the work of Mundkur & Thirumalachar (1946) only. However, recently Bagyanarayana and Ravinder (1995) examined the type specimen of *Puccinia erebia* and found it to be a species of *Prospodium*. Therefore, they made the necessary nomenclatural change, i.e. *Prospodium erebiae* (H. & P. Sydow) Bagyan & Ravinder comb. nov.

Prospodium tirumalensis is a distinct species and differs from *Prospodium erebiae* in both the urediniospore and teliospore characters. The urediniospores of *P. tirumalensis* are narrowed and longer, whereas they are comparatively shorter and broader in *P. erebia*. The teliospores of *P. erebia* are broadly ellipsoid with almost round apices and longer pedicels, whereas they are cylindraceo-ellipoid with somewhat conical ends and comparatively short pedicels in *P. tirumalensis*. In addition, the telia are pulvinate in *P. tirumalensis* and mesospores are also present.

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MYCOLOGICAL NOTES ON TWO RUST FUNGI REPORTED FROM INDIA

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Aecial stage of *Melampsora oblonga* Bagchee:

The genus *Melampsora* was established by Castagne (1843) with *M. euphorbiae* as its type species. Since then many species have been described, but Cummins (1959) and Hiratsuka and Cummins (1983) mentioned that all of them are not distinct morphologically. Species of *Melampsora* show both autoecious and heteroecious life-cycle pattern. The heteroecious species form their aecial stages on members of the Pinaceae and produce uredinial and telial stages on *Populus* and *Salix* of Salicaceae. According to Peterson (1974), more than 15 *Melampsora* species alternate between Pinaceae and Salicaceae. In addition to being the aecial hosts of heteroecious *Melamspora* species. Some members of the Pinaceae have been described to be parasitized by two microcyclic species, viz. *M. farlowii* (Arth.) J.J. Davis on *Tsuga canadensis* and *M. oblonga* Bagchee on *Pinus wallichiana* (=*P. excelsa*), but during a study of the rusts of *Pinus*, the author has examined the type specimen of *M. oblonga* and found aecia in addition to telia. A description of aecia is given below.

Aecia present on needles, subhypodermal, mostly covered, usually surrounded by telia; aeciospores 29-37 x 21-32 µm, globose, ellipsoid or broadly ellipsoid, wall 2-2.5 µm thick, verrucose, golden yellow.

With this report of the occurrence of aecia *M. oblonga* has to be classified as Cata-opsis type of life-cycle (Peterson 1974). As Bagchee (1950) reported the ready germination of teliospores, this species, like that of *M. farlowii*, is a Lepto-form.

Validity of *Puccinia citrullina* Raghunathan & Ramakrishnan

Raghunathan and Ramakrishnan (1973) described *Puccinia citrullina* on *Citrullus vulgaris* Schrad as a new species. They described uredinia, telia and uredinio-and teliospores respectively. However, the original description does not contain a Latin diagnosis.

According to Article 36 of ICBN this species is invalid. In order to make this species valid, a Latin description is presented.

Puccinia citrullina Raghun & Ramakr ex Bagyan sp. nov.

Spermogoniis et aeciis ignotis.

Urediniis amphigeniis, plerumque hypophyllis, brunneis, sparsis; urediniosporiis obovoideis vel late ellipsoideis, 22-31 x 17-22 µm, membrana 1-2 µm crassa, cinnamomeo-brunneis, echinulatis; poris germinativis 3-4, sparsis; teliis similaris urediniis, atro-brunnea; teliosporiis oblongis vel ellipsoideis, 26-38 x 17-26 µm, ad apicem rotundatis, membrana 2-3 µm crassa, castano-obrunneis, verrucosis; pedicello hyalino, 60 µm longis.

Holotypus: On *Citrullus vulgaris* Schrad., Coimbatore, November, 1962, A.N. Raghunathan, Mycological Herbarium, Tamil Nadu Agricultural University, Coimbatore 1117.

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THE GENUS PSATHYRELLA IN SPAIN. II. PSATHYRELLA LONGICYSTIDIATA SP. NOV.

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Abstract.- *Psathyrella longicystidiata* sp. nov., a new species collected in Spain, is described and illustrated. Besides, it is compared with other related species of sect. *Spintrigerae* (Fr.) Konrad & Maubl., viz. *P. candolleana* and *P. spintrigera*.

Key words: Agaricales, *Psathyrella longicystidiata*, taxonomy, ecology, Spain.

INTRODUCTION

Since 1996, one of us (M.H.) is working on the genus *Psathyrella* in the context of a large scale Spanish Research Project (*Flora Micológica Ibérica*) whose final aim is editing and publishing a flora that enables identification of fungi fruiting naturally in the Iberian Peninsula and the Balearic Islands. Therefore, we intend to publish a series of notes before finally editing a flora on *Psathyrella* in Spain.

As mentioned in a previous paper (HEYKOOP & ESTEVE-RAVENTÓS, 1994) the genus *Psathyrella* (Fr.) Quél. is a taxon to which little attention has been paid in Spain being often neglected by the majority of mycologists. With the exception of the contributions of ESTEVE-RAVENTÓS & BARRASA (1989), ESTEVE-RAVENTÓS & ENDERLE (1992) and HEYKOOP & ESTEVE-RAVENTÓS (l.c.), no monographical works have been carried out in this interesting, though difficult genus in our country. The same lack of knowledge remains on a larger European scale, altough we must mention the excellent work achieved by KITS VAN WAVEREN (1985, 1987) which represents a milestone in the systematic arrangement and comprehension of this genus. Furthermore, we must also refer to the excellent papers published by ROMAGNESI (1966, 1975, 1982, 1986) and ÖRSTADIUS (1986, 1992), among others, and, very

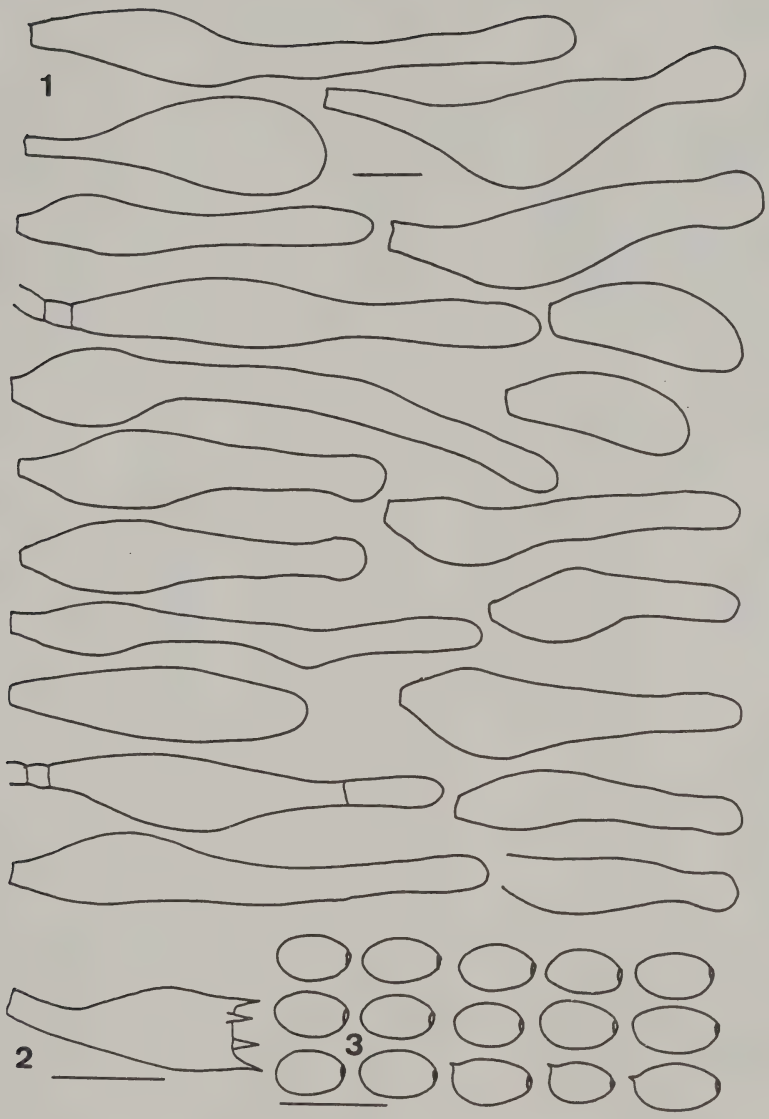
especially, to the series of studies carried out by M. Enderle in Germany (see ENDERLE, 1997, for a complete compilation of the works done on *Psathyrella* by this author). In the rest of the world some interesting papers have been published, too. So, in North America we must refer to the monograph of SMITH (1972), in North Africa to that of MALENÇON & BERTAULT (1970), and to the study of PEGLER & YOUNG (1992) focused on tropical species with ornamented spores.

The material studied was collected in the campus of our University. Unfortunately, the exact site where this species was collected, has been destroyed in order to improve the garden in which it grew, and since then it was not collected again, and neither will it be –presumably- in the future, at least not in its original locality. However, the collection consists of a large number of carpophores and despite the fact that we have only one collection, we think it is sufficiently characterized as a species in its own right to be described as new to science. Type material has been deposited at AH (Herbarium of Alcalá de Henares University, Spain). Drawings of the figures were made with the aid of a camera lucida. Basidiospore measurements were made following the method of HEINEMANN & RAMELOO (1985). The colours mentioned in the description refer to the colour chart of the British Fungus Flora (HENDERSON & al., 1969).

Psathyrella longicystidiata **Heykoop & G. Moreno sp. nov. Figs. 1-16**

Etymology: because of its very long cheilocystidia.

Basidiomata gregaria vel caespitosa. Pileus 10-30 mm latus, conico-convexus vel convexus, hygrophanus, non striatus, initio fulvus vel brunneus, in sicco pallide cremeus vel albidus, centro ochraceus, colore rosea destitutus, nec rugulosus, nec atomatus. Velum album, primo dense fibrillosum, dein centro pileo evanescens, fibrillas pilei marginem formans. Lamellae primo albidae vel cinereo-albidae vel leviter lilacinae, deinde violaceo lilacinae, adnatae, crebrae, acie albae. Stipes 30-70 x 3-6 mm, cylindraceus, plus minusve robustus, albus vel cremeo-albidus in parte inferiore, eradicatus, apice pruinosus. Odore saporeque nullis. Sporae in cumulo non observatae, 7-7,75-9 x 4,5-5,18-5,8 µm, ellipsoideae vel ellipsoideo-ovoideae, nec phaseoliformes, leves, in NH_4OH 10% observatae aurantiaco-brunneae, poro germinativo distincto munitae. Basidia 21-32 x 7-8,5 µm, clavata, 4-sporigera, fibulata. Pleurocystidia nulla. Cheilocystidia longissima, (40)45-98(100) x 7-13(14) µm, numerosa, aliquot (sub)utriformia vel subcapitata, plurimum lageniformia apicibus plus minusve obtusa, nonnulla flexuosa vel cylindracea, plerumque interna septata, tunica tenui praedita, colore carentia, nonnulla leviter lutea in NH_4OH 10% subcrasse tunicata, cellulis spheropedunculatis et clavatis 13-20 x 7-13µm intermixta. Caulocystidia cheilocystidiis similia (usque ad 95 µm longa) vel graciliora, cellulis clavatis intermixta. Trama lamellarum distincte colorata. Pileipellis e cellulis formata, nec



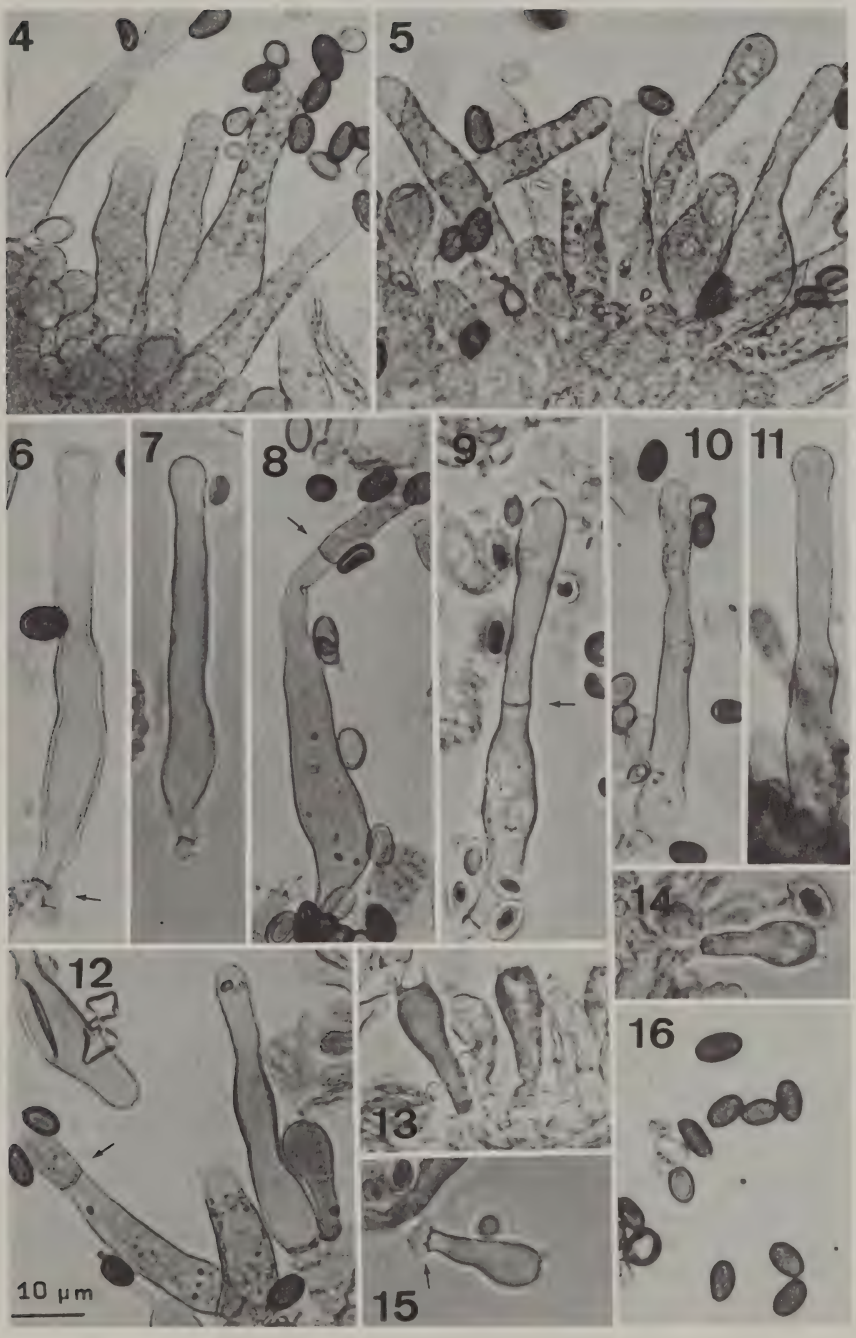
Figs. 1-3.- *Psathyrella longicystidiata* Holotype. 1. Cheilocystidia (barr = 10 µm); 2. Basidium (barr = 10 µm); 3. Spores (barr = 10µm).

colorata. Terrestris, in terram inter graminis sub Olea europaea L. Typus: Hispania, Complutum, Campus Universidad Alcalá, 12 January 1996, *leg.* F. Esteve-Raventós, S. Gómez & M. Villarreal, AH 22.658.

Basidiomata gregarious to fasciculate forming groups of 9-10 basidiocarps. Pileus 10 to 30 mm in diam., conico-convex to convex, hygrophanous, not striate, at first fulvous (12), drying out first at margin to pale cream or more whitish (5Ea or 4D), the centre remaining ochre (9H) some time, without pink, neither rugulose nor micaceous. Veil densely fibrillose, white, at maturity progressively disappearing and leaving many fibrils along the margin of cap and scattered isolated fibrils further up. Gills at first whitish to whitish-greyish to slightly lilac, then violaceous lilac, adnate, very close, lamella-edge white. Stipe 30-70 x 3-6 mm, more or less strong, pure white to white with a flush of cream at the lower half (due to water), not rooting, with pruinose apex. Smell and taste not distinctive. Spore print not recorded.

Spores 7-7.75-9 x 4.5-5.18-5.8 µm; Q= 1.27-1.50-1.73, (n=25), ellipsoid, some of them ellipsoid-ovoid, not phaseoliform, smooth, with apical germ pore (1-1.5 µm), orange-brown (in NH_4OH 10%), endospore well defined and visible. Basidia clavate, clamped, tetrasporic, e.g. 22 x 8.5 µm. Pleurocystidia absent. Cheilocystidia very long, visible under lens !, (40)45-98(-100) x 7-13(14) µm, numerous, some (sub)utriform to subcapitate, but mainly lageniform with more or less obtuse apex, very few flexuose to cylindrical, a large number septate internally, thin-walled, hyaline but a small number with slightly refringent and thicker walls (yellowish in NH_4OH 10%), intermixed with clavate to spheropedunculate cells. Caulocystidia similar to cheilocystidia (up to 95 µm in length) or somewhat more slender, intermixed with clavate cells. Hymenophoral trama consisting of hyphae with smooth membranal pigment, refringent in NH_4OH 10% (yellowish-greenish). Pileipellis a 2-3 cells deep layer of globose, colourless cells, 22-40 µm diam. Pileitrama and stipititrama consisting of hyphae with slightly encrusting pigment. Veil filamentous, consisting of hyphae with long elements, up to 5 µm wide, septate, clamped, with smooth membranal pigment, sometimes also slightly encrusting.

Figs. 4-16.- *Psathyrella longicystidiata* Holotype. 4-12. Cheilocystidia (arrows show internal septation and clamps); 13-15. Basidia (arrow shows clamp); 16. Spores.


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10 µm

Material examined: SPAIN- Alcalá de Henares, Campus of the University of Alcalá, 12 January 1996, leg. F. Esteve-Raventós, S. Gómez & M. Villarreal, on soil among grass under *Olea europaea* L., AH 22.658 Holotype.

Discussion: Because of the lack of pleurocystidia, spore length (< 10 µm) and width of basidia, this species belongs clearly to sect. *Spintrigerae* where it keys out (KITS VAN WAVEREN, 1985) closest to *Psathyrella candolleana* (Fr.:Fr.) Maire in Maire & Werner and *P. spintrigera* (Fr.) Konrad & Maubl. *P. longicystidiata* differs, however, from both because of its very different cheilocystidia which are surprinsingly long. The differences between these three species are tabulated below (table. I). Macroscopically *P. longicystidiata* may remind of *P. spintrigeroides* P.D.Orton (see illustration of M. Enderle, published by CETTO, 1993: 84) because of the pileus colour and the strongly developed veil on cap. The latter however belongs to sect. *Spadiceae* (Morg.) Kits van Wav. emend., and differs by its thick-walled pleuro- and cheilocystidia, which are, besides, shorter and differently shaped.

We do not know any species of *Psathyrella* which presents such large and characteristic cheilocystidia, not even in the numerous taxa treated in the monograph of SMITH (1972). So, we conclude that this taxon is a well-defined *Psathyrella* characterized principally by its very long and mainly lageniform cystidia with obtuse apex.

ACKNOWLEDGEMENTS

We wish to express our gratitude to the DGICYT ("Ministerio de Educación y cultura") for granting the Research Project PB95-0129 which enabled us to carry out this study. We are grateful to M. Enderle (Germany) for revising the manuscript and for allowing us to use his drawings of this new species.

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[1] Spore size in both *Psathyrella candolleana* and *P. spintrigera* are, however, variable. We have found typical collections of *P. spintrigera* with spores 7-8.5 x 4.5-5.5 µm, slightly wider than the measurements published for this species (e.g. GRÖGER, 1984). On the other hand, the differences between these two species are not always sharp and characters such as spore size, colour of cap and presence of a ring or cuff on the stipe do not seem to separate unambiguously both species. As a matter of fact we have collected specimens which are intermediate between both taxa. This problem will be treated in a future paper.

	Ring or cuff on stipe	Spore size	Cheilocystidia Shape	Cheilocystidia size
Psathyrella longicystidiata	Absent	7-9 x 4.5-5.8 µm	Chiefly lageniform with obtuse apex, but also (sub)utriform to subcapitate; some of them with slightly refringent walls	(40)45-98(-100) x 7-13(14) µm
Psathyrella candolleana	Absent	6.5-9 x 4-5 µm	Chiefly utriform but many cylindrical, subcylindrical or clavate; thin-walled and colourless	30-70 x 9-18(20) µm
Psathyrella spintrigera	Present	7-8 x 4.5(-5) µm acc. Kits van Waveren (1985)[1]	Chiefly utriform but also clavate or subcylindrical with very obtuse apex; thin-walled and colourless	25-37.5 x 10-15 µm

Table I. Differences between *Psathyrella longicystidiata*, *P. candolleana* and *P. spintrigera*.

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A STUDY OF SELECTED MURRILL'S RUSSULAS

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ABSTRACT

Microscopic descriptions and illustrations are presented on eleven of Murrill's *Russula* type collections: *Russula cremeirosea, R. cremeirubra, R. cystidiosa, R. incarnaticeps, R. inedulis, R. luteispora, R. obscuriformis, R. praetenuis, R. roseitincta, R. subfragiliformis,* and *R. subsericeonitens.*

INTRODUCTION

Attempts to identify to species some of the Russulas collected on forays conducted by mycological organizations in the Northeastern United States, (Maine to New Jersey), occasionally resulted in merely verifying that their characteristics did not correspond to published descriptions of Russulas indigenous to the area. In some instances the data conformed with available information on Murrill's Florida species, and the collection was tentatively labeled with the Murrill epithet. But because of the brevity of his descriptions, (which are reproduced in this paper), and the absence of detailed microscopic characteristics, notwithstanding Hesler's (1960) and Singer's (1957) observations, the assignment of the specific epithet was not accomplished with any degree of confidence. Hence eleven of Murrill's type collections have been studied to obtain information necessary to provide for a more conclusive identification.

MATERIALS AND METHODS

Illustrations were made with the aid of a drawing tube. Spores were examined from the lamellae, mounted in Melzer's reagent, size determined in lateral view, with ornamentation excluded. The pileus was studied when possible from tangential sections revived in 10% NH_4OH and 3-4% KOH. Gelatinous matrices were observed in NH_4OH and normally dissolved in KOH. Hyphal structures are described as observed in KOH. The subhymenium was observed at 1250x in a KOH mount stained with Congo Red. The tissue is described as prosenchymatous when filamentous hyphal elements were discernible; as pseudoparenchymatous when only inflated cells were present. While sulphovanillin (SV) should be used on fresh material where the darkening of the contents of cystidia is maximized, its present reaction with the dried material has been noted.

TAXONOMY

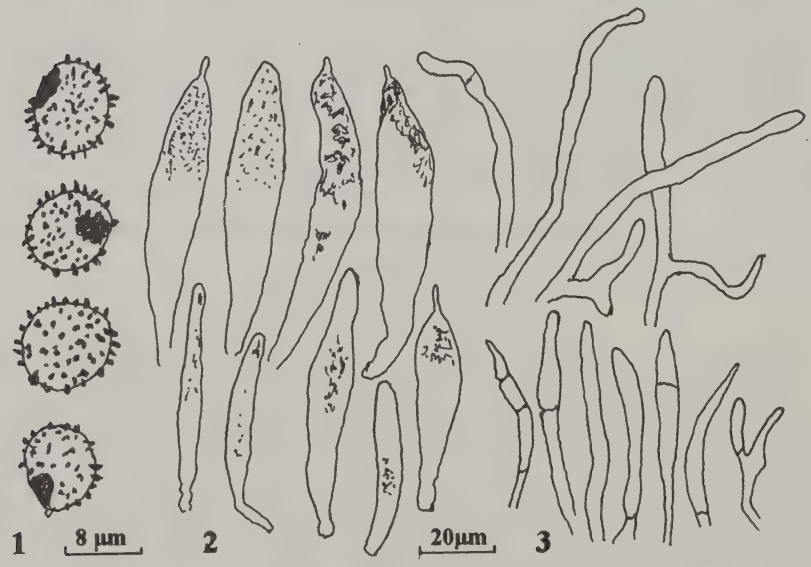
Russula cremeirosea Murrill, Lloydia 8: 265. 1945. Figs. 1-3.
Holotype: W. A. Murrill, 9 Jul 1938, Newnan's Lake, near Gainesville, FL, F9326 (FLAS).

"Pileus convex to slightly depressed, solitary, 7 cm. broad; surface smooth, glabrous, rose and cream, margin even, entire, incurved on drying; context thin, white, unchanging, odorless, mild; lamellae adnate, mostly equal, some forked, rather narrow, subcrowded, yellow at maturity; spores globose or subglobose, densely spinulose, stramineous, 6-8μ; stipe equal, smooth, glabrous, white with a faint pink blush, somewhat discolored on drying, 5x1.7 cm.

Type collected by W. A. Murrill under oak at Newnan's Lake, near Gainesville, Fla., July 9, 1938 (F 9326). The pileus is slightly sticky when moist. After prolonged drying it assumes a uniform, dull, old-rose color. There are no cheilocystidia. Near *R. xerampelina* Fr."

The type collection consists of 1 specimen in a fair state.

Spores 8.4-10.4 x 7.2-8.8 μm, subglobose, broadly elliptic, broadly obovate; ornamentation of amyloid warts 0.8-1.2 μm high, isolated, few connate; suprahilar area strongly amyloid; hilar appendix inamyloid, indiscernible. **Basidia** 40-46 x 10-14 μm, clavate, 4-sterigmate. **Hymenial cystidia** 46-96 x 6-15 μm, subcylindric, fusoid-clavate,

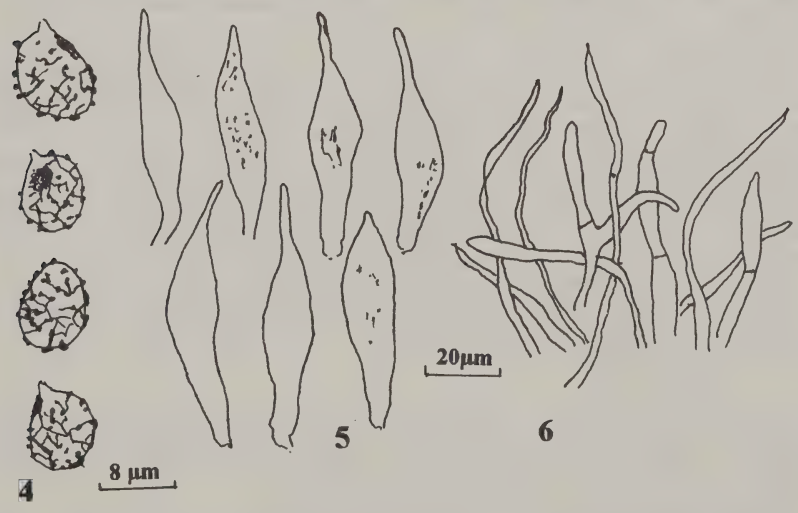


FIGS. 1-3. *Russula cremeirosea* (Murrill holotype, F9326 FLAS). 1. Spores. 2. Hymenial cystidia. 3. Hyphal ends from pileus cuticle.

fusiform, apices rounded, acute, some appendiculate, empty or lightly granular in upper area, SV- or partially weakly graying, arising in the subhymenium, projecting to 30 µm above basidioles, infrequent to common. **Subhymenium** pseudoparenchymatous to prosenchymatous. **Trama** with infrequent short lengths of smooth vascular hyphae 3-6 µm wide. **Pileus cuticle** 80-160 µm thick, embedded in a gelatinous matrix, interwoven, repent to ascending, hyaline, branching, infrequently septate, often constricted hyphae 3-6 µm wide, apices rounded to acute; also with smooth vascular hyphae 3-8 µm wide, without pileocystidia and oleiferous hyphae. (Hyphae in the lower portion are more horizontal in orientation but once the matrix is dissolved in a KOH mount, their predominant orientation is ascendant and some of the surface hyphae become erect.) **Stipe cuticle** longitudinal-interwoven, hyaline hyphae 3-6 µm wide, ends rounded, projecting only slightly; also with infrequent embedded smooth vascular hyphae.
(Hesler (1960), type study.)

Russula cremeirubra Murrill, Lloydia 8: 265. 1945. Figs. 4-6.
Holotype: W. A. Murrill, 22 Aug 1943, Arredonda, near Gainesville, FL, F12100 (FLAS).

"Pileus depressed, solitary, 7 cm. broad; surface smooth, glabrous, pale-cream suffused with pale-red, margin subentire, pectinate-striate; context thin, white, unchanging, odorless, mild; lamellae adnate, few inserted, broad, ventricose, rather distant, straw-colored, entire; spores ellipsoid, densely and distinctly echinulate, pale-yellow, about 9x7µ; cystidia rather abundant on gill-edge, inflated, short, abruptly apiculate; stipe equal,



FIGS. 4-6. *Russula cremeirubra* (Murrill holotype, F12100 FLAS). 4. Spores. 5. Hymenial cystidia. 6. Hyphal ends from pileus cuticle.

solid, smooth, glabrous, white, unchanging, 5x1.5 cm.

Type collected by W. A. Murrill in turkey-oak woods at Arredonda, near Gainesville, Fla., Aug. 22, 1943 (F 12100). A rare species with peculiar coloring."

The type collection consists of 1 specimen in a good state.
Spores 7.2-9.6 x 6.4-7.2 µm, obovate, broadly elliptic; ornamentation of amyloid warts 0.4-0.6 (-0.8) µm high, frequently catenulate, fine lines and particles which often combine to form a few meshes and a broken reticulum; suprahilar area amyloid; hilar appendix inamyloid, inconspicuous. **Basidia** 28-36 x 11-14 µm, clavate, 4-sterigmate. **Hymenial cystidia** 50-70 x 9-14 µm, ventricose-rostrate, fusoid, apex acute to appendiculate, appendage variable in length, to 16 µm, slightly granular to mostly empty, arising in the subhymenium, projecting usually less than 20 µm, infrequent. **Subhymenium** prosenchymatous. **Trama** with numerous smooth vascular hyphae 3-9 µm wide. **Pileus subcutis** 40-60 µm thick, tightly compressed horizontal-interwoven hyphae 1-3 µm wide, appearing prosenchymatous. **Pileus epicutis** 50-70 µm thick, embedded in a gelatinous matrix, repent, ascending to erect, hyaline, 2-6 µm wide hyphal ends, apices acute to rounded; without pileocystidia or oleiferous hyphae. **Stipe cuticle** with numerous embedded smooth vascular hyphae 4-12 µm wide, some tips projecting through the surface.
(Hesler (1960), type study.)

Russula cystidiosa Murrill, Bull. Torrey Bot. Club 67: 145. 1940. Figs. 7-9.
Holotype: W. A. Murrill, 29 Sep 1938, Sugarfoot Hammock, near Gainesville, FL, F18353 (FLAS).

"Pileus convex to depressed, gregarious, 5-7 cm. broad; surface somewhat viscid, glabrous, uniformly miniatous, peeling readily, margin entire, short-striate; context thin, white, unchanging, odorless, mild; lamellae attenuate behind, equal, not forked, medium broad and medium distant, entire, white to pale-yellow; spores subglobose to broadly ellipsoid, apiculate, spinulose, 1-guttulate, ochroleucous in mass, 8-12 x 6-10µ; cystidia clavate or fusoid, pointed or blunt, hyaline, thin-walled, about 30-60 x 8-12µ; stipe subequal, smooth, glabrous, white, unchanging when dried, about 7 x 1-2 cm.

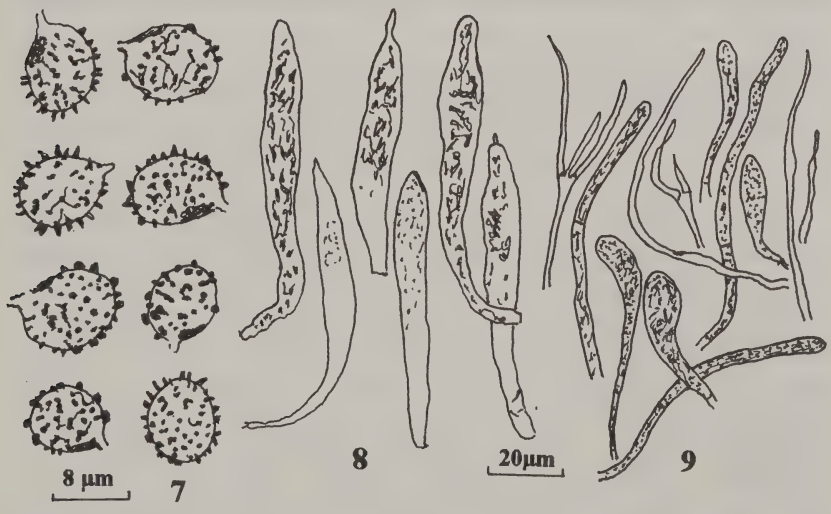
Type collected by West, Arnold and Murrill under an oak in a high hammock at Sugarfoot, near Gainesville, Fla., Sep. 29, 1938 (F 18353). Related to *R. subrubescens* but uniformly bright-red with milk-white stem."

The type collection consists of 8 specimens in a relatively good state. This is a mixed collection. Three specimens (#2, 6, 8) have a pileus cuticle and stipe surface without cystidia. The spores have a broken to complete reticulum.

specimen #2 - stipe 3.0 x 1.0 cm, with base broken off.
specimen #6 - stipe 3.8 x 0.7 cm, curve at base, saddle disc.
specimen #8 - stipe 2 x 0.4 cm, small, immature, no spores.

specimen #1 - stipe 4.2 x 1.4 cm.
specimen #3 - largest pileus, 5.5 cm diameter.
specimen #4 - stipe 3.4 x 1.0 cm.
specimen #5 - stipe 5.0 x 0.9 cm, 80 degree bend at base, pink on stipe.
specimen #7 - stipe 4.5 x 1.1 cm.

Microscopic observations of these five specimens are: **Spores** 7.6-10.4 x 6.4-8.0 µm, broadly elliptic, broadly obovate, subglobose; ornamentation of amyloid, warts 0.8-1.3 µm high, mostly isolated, some catenulate, or with a few fine connectives; suprahilar area a lightly amyloid patch; hilar appendix inamyloid, almost indistinguishable in Melzer's. **Basidia** 38-46 x 13-15 µm, clavate, 4-sterigmate. **Hymenial cystidia** 50-96 x 8-13 µm, subcylindric, subclavate, fusoid-clavate, apices varied, narrowly rounded, acute, often mucronate to appendiculate, empty to more often partially or completely filled with a grayish refractive content in the form of narrow bands or granules, weakly SV+, arising from subhymenium or trama, projecting to 40 µm beyond basidioles, abundant. **Subhymenium** pseudoparenchymatous to prosenchymatous. **Trama** with 4-6 µm wide smooth vascular hyphae. **Pileus subcutis** 50-110 µm thick, yellowish-pink in mass (alkali mount), horizontal-interwoven hyphae 1.6-3.2 µm wide; also with oleiferous and 6-10 µm wide smooth vascular hyphae. **Pileus epicutis** 60-100 µm thick, embedded in a gelatinous matrix, ascending to erect filamentous hyphae 2-4 µm wide tapering to an acute apex; also with numerous, weakly SV+, aseptate, clavate to ventricose pileocystidia 5-10 µm wide,



FIGS. 7-9. *Russula cystidiosa* (Murrill holotype, F18353 FLAS). 7. Spores. 8. Hymenial cystidia. 9. Hyphal ends from pileus cuticle.

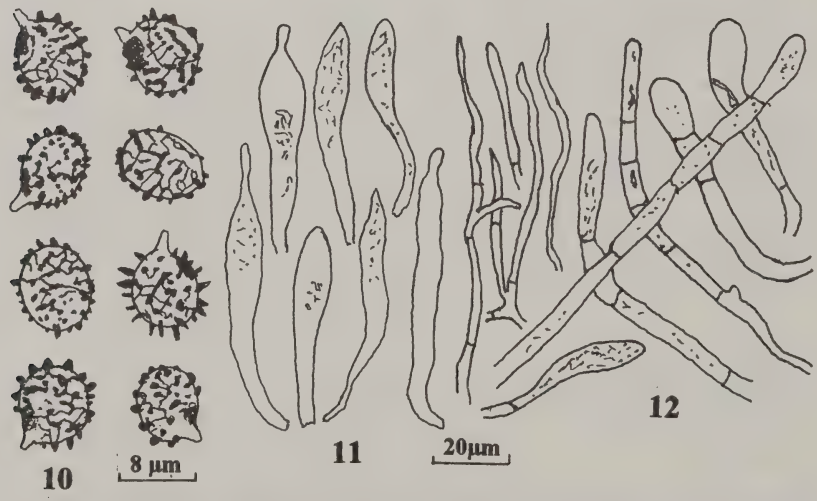
and abundant, weakly SV+, cylindrical, septate, ascending ends of oleiferous hyphae 4-8 µm wide. Stipe cuticle with abundant, weakly SV+, cystidia and oleiferous hyphae as in the pileus epicutis and infrequent embedded smooth vascular hyphae.
(Hesler (1960), type study; Singer (1957), description.)

Russula incarnaticeps Murrill, Bull. Torrey Bot. Club 67: 277. 1940. Figs. 10-12.
Holotype: W. A. Murrill, 23 Nov 1938, Sugarfoot Hammock, near Gainesville, FL, F18429 (FLAS).

"Pileus convex to deeply depressed, solitary or gregarious, 6-9 cm. broad; surface slightly viscid, smooth, glabrous, incarnate, margin striate, peeling, entire; context thin, white, odorless, mild; lamellae adnate, broad, ventricose, overlapping, close, equal,, many forked at the base, entire, white to slightly yellowish; spores globose or subglobose, distinctly echinulate, granular, cremeous in mass, 8-10 x 7-8µ; sterile cells frequent, hyaline, inflated at the base and abruptly tapering; stipe subequal, smooth, glabrous, white, unchanging, 5-6 x 1.5-2 cm.

Type collected by E. West and W. A. Murrill under oaks in Sugarfoot Hammock, November 23, 1938 (F 18429). A fine-looking, large, cool-weather species with very little flesh, drying light and fragile. The sterile cells are shaped like ink-bottles containing short-handled pens."

The type collection consists of 7 specimens in a good state.
Spores 7.2-9.2 x 6.0-7.2 µm, broadly obovate, broadly elliptic; ornamentation of amyloid, broadly convex to cylindrical warts 0.6-1.4 µm high, some isolated but more frequently



FIGS. 10-12. *Russula incarnaticeps* (Murrill holotype, F18429 FLAS). 10. Spores. 11. Hymenial cystidia. 12. Hyphal ends from pileus cuticle.

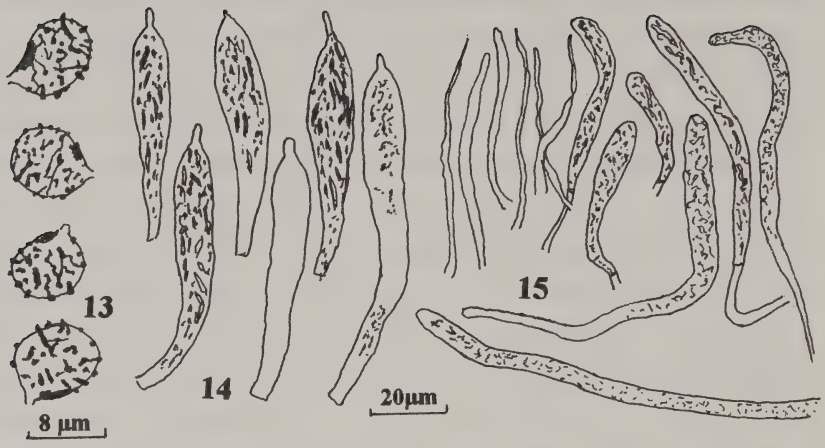
catenulate, with short bands and fine lines often forming a broken reticulum; suprahilar area an amyloid patch, occasionally with enough ornamentation to be slightly raised and strongly darkened; hilar appendix inamyloid, conspicuous. **Basidia** 38-46 x 12-16 µm, clavate, 4-sterigmate. **Hymenial cystidia** 46-72 x 6-12 µm, subcylindric, clavate, fusoid-clavate, apices rounded, acute, appendiculate, empty or with scattered granular-refractive areas, SV-, arising from subhymenium, projecting to 20 µm beyond the basidioles, uncommon. **Subhymenium** prosenchymatous. **Trama** with smooth vascular hyphae. **Pileus subcutis** 40-60 µm thick, horizontal-interwoven, tightly compressed, 1-3 µm wide hyphae; also with clear to lightly granular vascular hyphae. **Pileus epicutis** 40-60 µm thick, embedded in a gelatinous matrix, repent, ascending to erect, hyaline hyphal ends 1-3.5 µm wide, apices subulate, acute, rounded; also with rare, when observed in a tangential section, repent to ascending, cylindrical to clavate vascular hyphal ends 3-10 µm wide, which are aseptate to septate, empty and SV-, or with sparce, weakly SV+, refractive, finely granular contents. (These vascular hyphae are more easily seen in a scalp section where they are scarce to common.) **Stipe cuticle** of longitudinal-interwoven, hyaline hyphae 2-4 µm wide, and common embedded vascular hyphae as in the pileus epicutis.
(Hesler (1960), type study; Singer (1957), description.)

Russula inedulis Murrill, Lloydia 7: 311. 1944. Figs. 13-15.
Holotype: W. A. Murrill, 24 Oct 1942, Gainesville, FL, F22465 (FLAS).

"Pileus convex to depressed, 7-8 cm. broad; surface viscid when moist, smooth, glabrous, mostly roseous but with small white or yellowish areas, margin even, undulate, scarcely peeling; context thick, firm, white, unchanging, odorless, mild but of poor quality; lamellae adnate, broad, crowded, becoming deep-yellow; spores globose, rough, yellow, 6-7µ; stipe enlarged below, smooth, glabrous, white, unchanging, about 5 x 1,5-3 cm.

Type collected by W. A .Murrill on a grassy lawn near laurel oak and longleaf pine in Gainesville, Fla., Oct. 24, 1942 (F 22465). A large, attractive species."

The type collection consists of 2 specimens in a good state.
Spores 7.6-9.6 x 6.4-7.6 µm, broadly obovate, broadly elliptic; ornamentation of amyloid convex warts 0.3-0.5 (-0.6) µm high, isolated, catenulate, ridges and fine lines with an occasional closure but not forming a reticulum; suprahilar area a weakly amyloid patch; hilar appendix short, inamyloid, very inconspicuous in Melzer's. **Basidia** 38-44 x 13-15 µm, clavate, 4-sterigmate. **Hymenial cystidia** 46-94 x 9-12 µm, fusoid-clavate, subclavate, apices subacute, mucronate, mostly appendiculate, empty or with granular to banded content, SV+, arising from subhymenium or trama, projecting up to 30 µm beyond basidioles, numerous. **Subhymenium** pseudoparenchymatous. **Trama** with smooth vascular hyphae 3-10 µm wide, infrequent to common. **Pileus subcutis** 40-80 µm thick, tightly compressed, horizontal-interwoven hyphae 2-4 µm wide. **Pileus epicutis** 60-100 µm thick, embedded in a gelatinous matrix, ascendant to erect hyphal ends 1-3 µm



FIGS. 13-15. *Russula inedulis* (Murrill holotype, F22465 FLAS). 13. Spores. 14. Hymenial cystidia. 15. Hyphal ends from pileus cuticle.

wide, apices acute to rounded; also with abundant, weakly SV+, aseptate, subclavate to cylindrical pileocystidia 40-110 x 6-10 µm, and cylindrical, aseptate, ascending oleiferous hyphal tips to 10 µm wide. **Stipe cuticle** with abundant oleiferous hyphae as in the pileus epicutis.

(Hesler (1960), type study; Singer (1957), description.)

Russula luteispora Murrill, Lloydia 7: 311. 1944. Figs. 16-18.

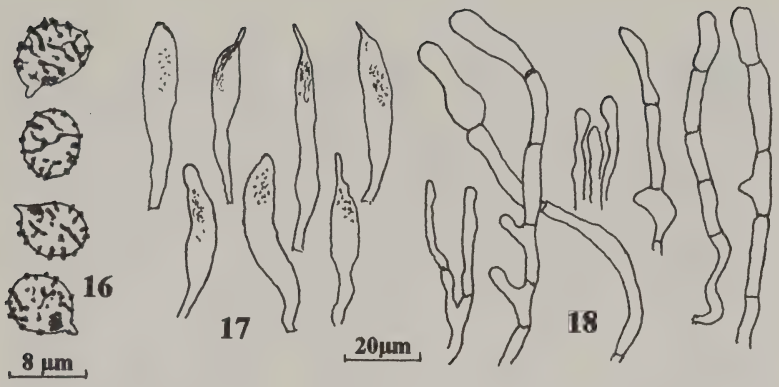
Holotype: W. A. Murrill, 14 Jan 1940, Gulf Hammock, Levy Co., FL, F18537 (FLAS).

"Pileus convex to depressed, solitary, 3.5 cm. broad; surface slightly viscid, smooth, glabrous, uniformly pale-incarnate, margin slightly striate and slightly undulate; context very thin, white, unchanging, odorless; lamellae adnexed, equal, plane, narrow, close, entire, pallid; spores broadly ellipsoid, rough, luteous in mass, about 7x5µ; cystidia none; stipe tapering downward, smooth, glabrous, white, 2.5x0.7-0.9 cm.

Type collected by W. A. Murrill in low ground under hardwoods at Gulf Hammock, Levy Co., Fla., Jan. 14,1940 (F 18537). A pretty little species with deep-yellow spores."

The type collection consists of 1 specimen in a poor state.

Spores 6.0-8.0 x 5.2-6.4 µm, subglobose, broadly obovate, broadly elliptic; ornamentation of amyloid warts 0.2-0.5 µm high, isolated, catenulate, with bands and lines sometimes forming a mesh but not a reticulum; suprahilar area amyloid; hilar appendix inamyloid, inconspicuous. **Basidia** 28-34 x 11-12 µm, clavate, 4-sterigmate. **Hymenial cystidia** 40-55 x 6-9 µm, subcylindric, fusoid-clavate, apices acute, appendiculate, empty to lightly granular, SV-, arising in the subhymenium, projecting to



FIGS. 16-18. *Russula luteispora* (Murrill holotype, F18537 FLAS). 16. Spores. 17. Hymenial cystidia. 18. Hyphal ends from pileus cuticle.

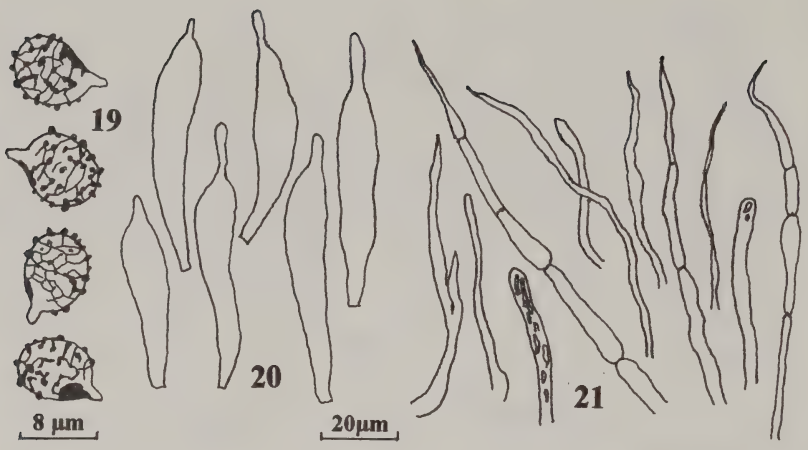
20 µm, infrequent. **Subhymenium** prosenchymatous. **Trama** with rare smooth vascular hyphae and short segments containing lightly granular particles. **Pileus subcutis** 20-40 µm thick, tightly compressed, horizontal-interwoven hyphae 1-2 µm wide, appearing prosenchymatous. **Pileus epicutis** 80-110 µm thick, embedded in a gelatinous matrix, repent, ascending to erect, hyaline hyphae 2-6 (-10) µm wide with rounded apices, of various lengths, short hyphae with long cells, many hyphae extend over 100 µm, are closely septate, often constricted, with cells 12-30 µm long, resembling primordial hyphae but empty and without any fuchsin staining granules, SV-; without pileocystidia and oleiferous hyphae. **Stipe cuticle** with infrequent segments of vascular hyphae 3-5 µm wide containing a few lightly refractive granules.
(Hesler (1960), type study.)

Russula obscuriformis Murrill, Lloydia 7: 312. 1944. Figs. 19-21.
Holotype: W. A. Murrill, 13 Jul 1938, La Crosse, Alachua Co., FL, F15536 (FLAS).

"Pileus convex to slightly depressed, solitary, 8 cm. broad, surface dry, smooth, at length glabrous, dark-roseous with bay center, darker on drying, margin even or slightly striate, entire, peeling readily; context thin, white, discoloring on drying, odorless, mild; lamellae adnate, mostly equal, few forked, broad, medium distant, entire, white; spores subglobose to broadly ellipsoid, finely tuberculate, stramineous in mass, about 8µ long; cystidia none; stipe equal, smooth, glabrous, white, 5x2 cm.

Type collected by W. A. Murrill under an oak at LaCrosse, Alachua Co., Fla., July 13, 1938 (F 15536). Suggesting *R. obscura* Romell but differing in color and spore color. The gills in dried specimens are distinctly gray."

The type collection consists of 1 specimen in a good state.
Spores 6.8-8.8 x 5.6-7.2 µm, obovate, broadly elliptic; ornamentation of amyloid warts

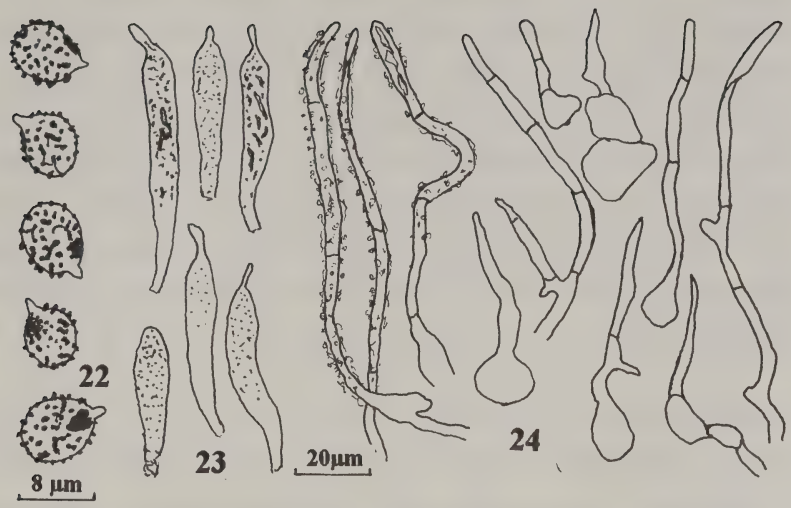


FIGS. 19-21. *Russula obscuriformis* (Murrill holotype, F15536 FLAS). 19. Spores. 20. Hymenial cystidia. 21. Hyphal ends from pileus cuticle.

0.4-0.8 µm high, short bands and fine lines forming a broken to complete reticulum; suprahilar area a patch varying from weakly to strongly amyloid; hilar appendix inamyloid, conspicuous. **Basidia** 30-42 x 12-14 µm, clavate, 4-sterigmate. **Hymenial cystidia** 40-66 x 9-14 µm, fusoid-clavate, ventricose-rostrate, appendiculate, appendage extending to 24 µm, empty, SV-, arising in the subhymenium, often embedded with only the appendage projecting or projecting to 20 µm beyond the basidioles, infrequent. **Subhymenium** prosenchymatous. **Trama** containing smooth vascular hyphae. **Pileus subcutis** 30-50 µm thick, yellowish in mass, tightly compressed, horizontal-interwoven hyphae 1-3 µm wide. **Pileus epicutis** 30-60 µm thick, embedded in a gelatinous matrix, repent, ascending to erect, hyaline, 40-80 x 1.5-3.6 µm hyphal ends, apices rounded to acute, and infrequent, slightly ascending, prominently constricted-septate hyphae 100-120 x 3-6 µm, end cells subulate; also with common embedded vascular hyphae 2.4-5 µm wide with rare erect rounded ends rising to the surface, the ends sometimes containing refractive granules, without pileocystidia or any SV+ elements. **Stipe cuticle** with embedded smooth vascular hyphae and some projecting hairs resembling the thin hyphae of the pileus epicutis.
(Hesler (1960), type study.)

Russula praetenuis Murrill, Lloydia 6: 215. 1943. Figs. 22-24.
Holotype: W. A. Murrill, 28 Jun 1942, Seven-mile Church, W of Gainesville, FL, F21508 (FLAS).

"Pileus convex to depressed, 2-3 cm. broad; surface glabrous, viscid when wet, uniformly incarnate, margin entire, peeling readily, widely striate; context very thin, white, unchanging, mild, odorless; lamellae adnate, many forked at the base, ventricose, broad,



FIGS. 22-24. *Russula praetenuis* (Murrill holotype, F21508 FLAS). 22. Spores. 23. Hymenial cystidia. 24. Hyphal ends from pileus epicutis.

medium distant, entire, white, unchanging; spores white, moderately rough, broadly ellipsoid, about 5-6x4.5-5µ; cystidia none; stipe tapering downward, solid, smooth, glabrous, white with a faint blush on one side, unchanging, about 2-3x0.5 cm.

Type collected by W. A. Murrill in a grassy road through woods of red oak, hickory, etc. at Seven-mile Church, west of Gainesville, Fla., June 28, 1942 (F 21508). A small, beautiful species, evidently rare. It is much more dainty than *R. uncialis* Pk."

The type collection consists of 2 specimens in a good state.

Spores 6.4-8.0 x 5.2-6.4 µm, predominantly 6.8-7.2 x 5.6-6.0 µm, obovate, broadly elliptic; ornamentation of amyloid warts 0.3-0.7 µm high, isolated, connate, short catenulate, and short bands or fine lines, without closures; suprahilar area sharply outlined amyloid patch, sometimes slightly raised or with marginal warts; hilar appendix inamyloid, noticeable. **Basidia** 28-38 x 10-14 µm, clavate, 4-sterigmate. **Hymenial cystidia** 40-64 x 7-10 µm, subcylindric, subclavate, apices subacute to rounded, mostly appendiculate, content variable, lightly banded, uniformly lightly granular, or almost empty, reaction to SV nil to very weak, arising from the subhymenium, embedded to projecting up to 20 µm, infrequent. **Subhymenium** 18-30 µm thick, pseudoparenchymatous, compacted cells 3-8 µm wide. **Trama** with infrequent smooth vascular hyphae. **Pileus subcutis** 80-130 µm thick, the lower 1/2-3/4 of gelatinous horizontal-interwoven hyphae 2-8 µm wide which merge into an upper portion of inflated cells 8-34 µm wide, in some areas forming a pseudoparenchymatous region up to 56 µm thick or in other areas with only one or two cells thick intermixed with interwoven-ascending hyphae; also with infrequent smooth

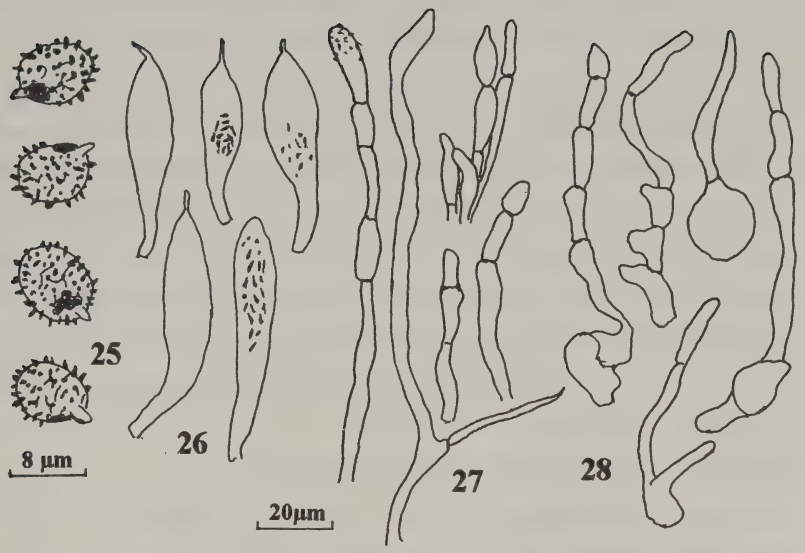
vascular hyphae. **Pileus epicutis** 30-60 µm thick, embedded in a gelatinous matrix, of two types of hyphae: ascendant to erect, hyaline, 20-80 x 2-6 µm, apices predominantly acute, rising from a swollen cell of the pseudoparenchymatous region (Fig. 24); also unevenly spaced primordial hyphae 70-150 x 3-4 µm, repent, ascending to erect, usually 3-5 septate, sometimes containing grayish-refractive areas which are SV+, often massed and entwining to form a yellowish pyramidal fascicle. (In a KOH mount, these hyphae appear to be densely incrusted with particles which are not SV+ or fuchsin reactive, and are probably related to the gelatinous matrix which dissipates in KOH, but not NH_4OH.) **Stipe cuticle** with projecting hyphae 60-80 x 3-4 µm, containing occasional granular-refractive areas similar to the long hyphae in the pileus epicutis but without any incrustation in KOH.
(Hesler (1960), type study; Singer (1957), description.)

Russula roseitincta Murrill, Bull. Torrey Bot. Club, 67: 278. 1940. Figs. 25-28.
Holotype: W. A. Murrill, 15 Nov 1938, Newnan's Lake, near Gainesville, FL, F18453 (FLAS).

"Pileus convex to plane, slightly depressed at the center, solitary, 6 cm. broad; surface slightly viscid when moist, smooth, glabrous, rosy-avellaneous-isabelline, margin even, entire, peeling; context thin, white, odorless, mild; lamellae adnate, equal, medium broad, rather close, many forked at the base, a few midway, entire, white, unchanging; spores white, mostly broadly ellipsoid, 1-guttulate, conspicuously and densely echinulate, 8-9 x 6-7µ; sterile cells few, hyaline, inflated, 20-30 x 15µ, with threadlike tips of varying lengths; stipe equal, smooth, glabrous, white, rose-tinted when dry, 5 x 1.2 cm.

Type collected by E. West and W. A. Murrill on the ground in mixed woods at Newnan's Lake, Fla., November 15, 1938 (F 18453). Near *R. rosei-isabellina* Murrill but with different microscopic characters and gill structure."

The type collection consists of 1 specimen in a poor state.
Spores 7.2-8.8 x 6.0-7.2 µm, obovate, broadly elliptic; ornamentation of amyloid warts 0.8-1.0 µm high, isolated, a few thin connectives usually present; suprahilar area an amyloid irregular patch; hilar appendix inamyloid, inconspicuous. **Basidia** 30-39 x 11-13 µm, clavate, 4-sterigmate. **Hymenial cystidia** 42-66 x 10-14 µm, fusoid-clavate, subclavate, apices rounded to acute, often appendiculate, appendage usually slender 4-8 x 0.8-1.6 µm, mostly empty, a few containing short thin bands, SV- or weakly SV+ in areas, arising in the subhymenium, projecting to 25 µm beyond the basidioles, infrequent. **Subhymenium** prosenchymatous. **Trama** without or with rare smooth vascular hyphae. **Pileus subcutis** variable: at marginal area 50-60 µm thick, gelatinous, tightly compressed, horizontal-interwoven hyphae 1.5-3 µm wide; at mid-radius the upper region is ascending-interwoven with some hyphae swollen to 16 µm thick and frequent subglobose inflated cells to 30 µm; in the disc area the inflated cells are so numerous that a pseudoparenchymatous layer 3 to 5 cells thick is formed; also with infrequent smooth



FIGS. 25-28. *Russula roseitincta* (Murrill holotype, F18453 FLAS). 25. Spores. 26. Hymenial cystidia. 27. Hyphal ends from mid-radius of pileus epicutis. 28. Hyphal ends from disc area.

vascular hyphae 4-6 µm wide. **Pileus epicutis** 50-80 µm thick, embedded in a gelatinous matrix which soon dissolves in KOH, ascending to erect, hyaline hyphae 3-8 µm wide, apices rounded to subacute; also with usually widely spaced, repent, obliquely oriented, recurved to erect, constricted-septate, slightly incrusted primordial hyphae 90-140 x 4-8 µm, a few clustered enough to form a fascicle extending beyond the normal surface; in the disc area the hyphae usually arise from a swollen cell (Fig. 28); without pileocystidia or SV+ oleiferous hyphae. **Stipe cuticle** with projecting hairs of septate hyphae resembling the primordial hyphae of the pileus epicutis and infrequent embedded smooth vascular hyphae 3-8 µm wide.
(Hesler (1960), type study; Singer (1957), description.)

Russula subfragiliformis Murrill, Lloydia 6: 217. 1943. Figs. 29-31.
Holotype: W. A. Murrill, 16 Jul 1938, Planera Hammock, FL, F17705 (FLAS).

"Pileus convex to depressed, gregarious or solitary, 5-8 cm. broad; surface slightly viscid, smooth, glabrous, red or incarnate, margin entire, sometimes striate, peeling readily; context white, unchanging, odorless, mild; lamellae adnate, mostly equal, medium distant, rather narrow, entire, becoming deep-ochraceous; spores globose or subglobose, echinulate, 6-8µ, cremeous in mass; stipe subequal, smooth, glabrous, white or partly pink, unchanging, about 4x1-1.5 cm.

Type collected by West, Arnold and Murrill on the ground under hardwood trees in Planera Hammock, eleven miles northwest of Gainesville, Fla., July 16, 1938 (F 17705).

Also collected frequently in similar situations about Gainesville (F 17661, F 17662, F 17700). A beautiful red species with mild flesh and pale-yellow spores."

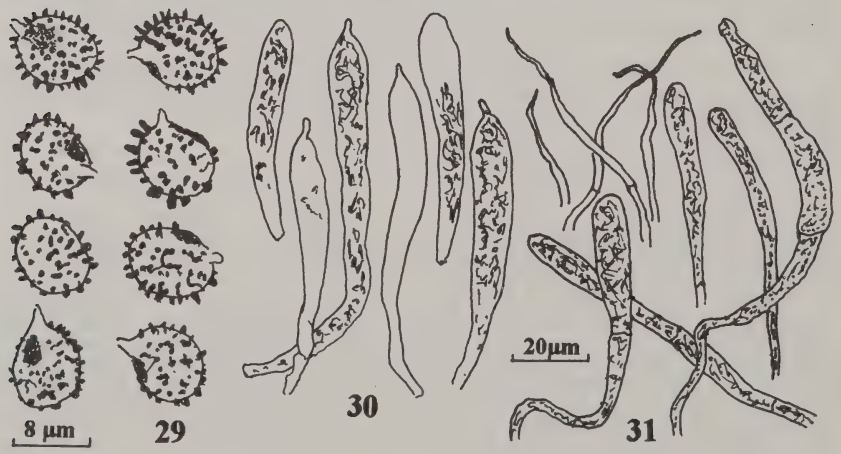
The type collection consists of 7 specimens in fair to poor condition, with much frass in the container. This is a mixed collection. Three specimens (#3,4,6) have no SV+ cystidia in the pileus cuticle or on the stipe surface. The spores on specimens 4 and 6 are larger, 8-12 µm long, and more elliptical in shape than the spores on the other specimens. Since Murrill stated "globose or subglobose, 6-8 µ", these two specimens could not be the basis for his *Russula subfragiliformis*. Singer (1957) had synonymized this species with *R. cystidiosa* and I concur in that the other four specimens in this collection (F17705) compare favorably with five of the specimens in the type collection of *R. cystidiosa* (F18353).

specimen #3 - with immature dark lamellae, and scarce immature spores.
specimen #4 - fragile, mostly insect eaten pileus.
specimen #6 - fragile, but more lamellae remaining than #4.

- - - - - - - - - -

specimen #1 - largest pileus.
specimen #2 - with stipe broken off.
specimen #5 - with short dark stipe.
specimen #7 - with split dark stipe.

Microscopic observations of these four specimens are: **Spores** 8.0-9.2 x 6.4-7.2 µm, subglobose, broadly obovate; ornamentation of amyloid warts 0.8-1.2 (-1.6) µm high, mostly isolated, a few catenulate, occasionally fine lines connecting 3-6 warts; suprahilar



FIGS. 29-31. *Russula subfragiliformis* (Murrill holotype, F17705 FLAS). 29. Spores. 30. Hymenial cystidia. 31. Hyphal ends from pileus cuticle.

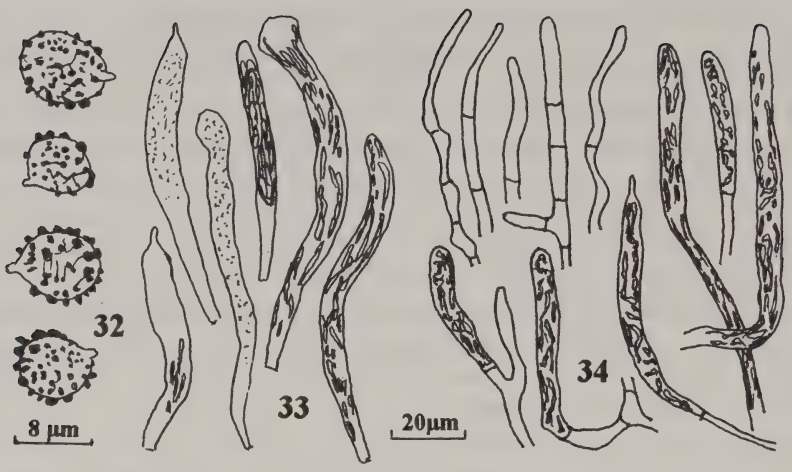
area an amyloid, sometimes raised patch. **Hymenial cystidia** 55-115 x 8-13 µm, subcylindric, subclavate, empty to more often filled with grayish refractive granular content, apices acute, mucronate, appendiculate, or rounded, extending to 40 µm beyond the basidioles, abundant, the lamella edge almost heteromorphous with cheilocystidia predominantly empty. **Subhymenium** pseudoparenchymatous to prosenchymatous. **Trama** with smooth vascular hyphae. **Pileus subcutis** 50-80 µm thick, yellowish-pink in mass, horizontal-interwoven hyphae 1.6-4 µm wide, also with clear vascular and oleiferous hyphae. **Pileus epicutis** 30-80 µm thick, embedded in a gelatinous matrix, repent, ascending to erect hyphae, with ends 50-80 x 2-4 µm tapering to an acute apex; also with abundant, weakly SV+, aseptate, clavate pileocystidia 6-9 µm wide and septate, cylindrical, ascending oleiferous hyphal tips. **Stipe cuticle** with abundant, weakly SV+, caulocystidia and oleiferous hyphae as in the pileus epicutis, also with infrequent embedded smooth vascular hyphae.
(Singer (1957), =*Russula cystidiosa*.)

Russula subsericeonitens Murrill, Bull. Torrey Bot. Club 66: 156. 1939. Figs. 32-34. Holotype: W. A. Murrill, 28 Oct 1938, Gainesville, FL, F18310 (FLAS).

"Pileus convex to slightly depressed, solitary, about 5 cm. broad; surface slightly viscid, smooth, subglabrous, opaque, atropurpureous, blackish on the disk, margin even, entire, peeling easily; context thin, white, unchanging, odorless, mild at first, becoming slightly acrid but eaten by squirrels; lamellae almost free, narrow and blunt behind, medium broad in front, mostly equal, none forked, medium distant, white, unchanging; spores chalk-white in mass, globose to broadly ellipsoid, distinctly echinulate, 1-guttulate, 6-8x6-7µ; cystidia none; stipe slightly tapering upward, glabrous, somewhat uneven, white, unchanging, 5x1-1.3 cm.

Type collected by W. A. Murrill in wet soil in a low hammock under pine and hardwood trees at Gainesville, Fla., Oct. 28,1938 (F 18310). Much like *R. sericeonitens* but drying thinner and lighter; and having spores that vary to broadly ellipsoid, gills that do not fork and are narrower and more distant, and flesh that tastes slightly acrid after a short time."

The type collection consists of 1 specimen in a good state.
Spores 6.4-9.2 x 5.2-7.2 µm, subglobose, broadly obovate, broadly elliptic; ornamentation of amyloid warts 0.7-1.0 µm high, some cylindric 0.6 µm wide, others convex to 1.5 µm wide, isolated, sometimes with very fine lines; suprahilar area a plage; hilar appendix inamyloid, short, inconspicuous. **Basidia** 38-48 x 10-13 µm, clavate, 4-sterigmate. **Hymenial cystidia** 50-98 x 6-12 µm, subcylindric, fusoid-clavate, apices acute, short appendiculate, some strangely capitate, empty, finely granular overall, or short banded with strongly refractive areas, incompletely SV+, arising in the trama and subhymenium, projecting to 30 µm beyond the basidioles, fairly numerous. **Subhymenium** pseudoparenchymatous to prosenchymatous. **Trama** with smooth



FIGS. 32-34. *Russula subsericeonitens* (Murrill holotype, F18310 FLAS). 32. Spores. 33. Hymenial cystidia. 34. Hyphal ends from pileus cuticle.

vascular hyphae. **Pileus subcutis** 60-90 µm thick, horizontal-interwoven hyphae 3-5 µm wide; also with smooth vascular hyphae and common oleiferous hyphae 4-7 µm wide. **Pileus epicutis** 40-80 µm thick, embedded in a gelatinous matrix, ascendant to erect, septate, hyaline, filamentous hyphae 3-5 µm wide, apices rounded; also with abundant subclavate, cylindric, aseptate pileocystidia 50-80 x 5-8 µm, and many cylindric, aseptate, 4-8 µm wide, horizontal to erect tips of the oleiferous hyphae, both with strongly refractive, granular-banded contents in KOH and weakly SV+. **Stipe cuticle** with infrequent embedded smooth vascular hyphae and abundant oleiferous hyphae as in the pileus cuticle.

(Hesler (1960), type study; Singer (1957), description.)

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WEDDELLOMYCES XANTHOPARMELIAE SP. NOV. AND ADDITIONS TO THE CHOROLOGY OF OTHER SPECIES OF THE GENUS

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Abstract : *Weddellomyces xanthoparmeliae* Calatayud et Nav.-Ros. sp. nov., a non lichenized lichenicolous fungus growing on *Xanthoparmelia* cf. *protomatrae,* is described from Madrid province (Spain). The new species resembles *W. erythrocarpae* by having spores with a very fine ornamentation in the inner perispore and prominent tori in the septa of the young spores. Both taxa differ in the size of the spores, which are smaller in *W. xanthoparmeliae,* only (22)-23-30-(32) × (7)-8-9-(10) µm. Additional chorological data are supplied for three other species of *Weddellomyces. W. heterochrous* Nav.-Ros. et Cl. Roux is reported from Spain, on *Aspicilia desertorum,* and *W.* aff. *protearius* Nav.-Ros. et Cl. Roux from Austria, on *Xanthoria elegans. W. epicallopisma* is mentioned for the first time from the Italian Peninsula and from Israel.

Resumen : Descripción de *Weddellomyces xanthoparmeliae* Calatayud et Nav.-Ros. sp. nov., un hongo liquenícola no liquenizado que crece sobre *Xanthoparmelia* cf. *protomatrae,* conocido sólo de la localidad del tipo (Madrid, España). *W. xanthoparmeliae* recuerda a *W. erythrocarpae* por tener esporas con ornamentación muy fina en el perisporio interno y con el toro prominente en los septos de las esporas jóvenes; pero ambos táxones se diferencian principalmente por el tamaño de las esporas, que es menor en *W. xanthoparmeliae,* con sólo (22)-23-30-(32) × (7)-8-9-(10) µm. Se aportan datos corológicos adicionales para otras especies de *Weddellomyces. W. heterochrous* Nav.-Ros. et Cl. Roux se cita de España, sobre *Aspicilia desertorum,* y *W.* aff. *protearius* Nav.-Ros. et Cl. Roux, de Austria, sobre *Xanthoria elegans. W. epicallopisma* se menciona por primera vez de Italia peninsular y de Israel.

Resumo : Priskibo de *Weddellomyces xanthoparmeliae* Calatayud et Nav.-Ros. sp. nov. ne likeniĝinta likenloĝa fungo parazita al *Xanthoparmelia* cf. *protomatrae,* kaj nur konata de la tipa loko (Madrid, Hispanio). *W. xanthoparmeliae,* parencas al *W. erythrocarpae* pro sporoj kun tre fajna ornamo ĉe la intera perisporo kaj elstaraj septotoroj, kiuj estas bone videblaj ĉe la junaj sporoj; tamen *W. xanthoparmeliae* diferencas de tiu ĉi lasta specio ĉefe pro sporoj pli malgrandaj, nur (22)-23-30-(32) × (7)-8-9-(10) µm. Oni inkludas novajn aldonojn pri la disvastiĝo de kelkaj specioj de *Weddellomyces. W. heterochrous* Nav.-Ros. et Cl. Roux estas menciita en Hispanio, parazita al *Aspicilia desertorum,* kaj *W.* aff. *protearius* Nav.-Ros. et Cl. Roux, en Aŭstrio, parazita al *Xanthoria elegans.* Fine *W. epicallopisma* estas unuafoje menciita en la Itala duoninsulo kaj en Izraelio.

Introduction

During the study of saxicolous and terricolous lichens from El Pardo mountain (Madrid, Spain), a lichenicolous fungus of the genus *Weddellomyces* D. Hawksw. 1986 (Dothideales 1897) growing on *Xanthoparmelia* cf. *protomatrae* was found. Its morphological characters, especially the structure and dimensions of the spores, differed from the other species previously known in this genus (Hawksworth 1986 and 1990, Alstrup & Hawksworth 1990, Alstrup 1992, Navarro-Rosinés & Roux 1995 and 1997).

As the fungus is not treated in the mentioned studies, nor in Clauzade & Roux (1976), Clauzade *et al.* (1989), Hawksworth (1983), Keissler (1930), Triebel (1989) and Vouaux (1912-1914), the conclusion can be drawn that this *Weddellomyces* is a new species, which is described here as *Weddellomyces xanthoparmeliae,* in reference to its typical host.

In this study, additional reports of three other species of the genus, *Weddellomyces epicallopisma, W. heterochrous* and *W.* aff. *protearius,* are also included, with comments on their chorology and on some aspects of their morphology.

Further information about the general characters of the genus *Weddellomyces* and its delimitation with regard to other close genera is supplied in the revision of the genus by Navarro-Rosinés & Roux (1995).

Material and methods

Handmade sections of the material were mounted in water, lugol (I), 10% diluted KOH (K) and lactophenol-cotton blue, to be examined with a light microscope, with a magnification of up to ×1500 . Only non-fresh, dead material was studied.

With the exception of the habit figure, all figures included in this study have been made with the help of a drawing tube fitted to the microscope.

For the measurements of the spores, the average value is indicated in italics, between the extreme values after rejecting 10% of the highest and the lowest values. The highest and the lowest absolute values are given in parenthesis.

Weddellomyces xanthoparmeliae Calatayud et Nav.-Ros. sp. nov.

Diagnosis

Weddellomyces erythrocarpae *Nav.-Ros. et Cl. Roux similis interna perispora tenuiter granulosa, sed ei dissimilis sporis minoribus. Ascosporae (22)-23-30-(32) longis et (7)-8-9-(10) µm latis, primo toris prominentibus instructae. Immersus in thallo* Xanthoparmeliae *cf.* protomatrae.

Typus.— Spain : Prov. Madrid, Madrid, El Pardo, alrededores de la carretera de Madrid a El Pardo, suelos provenientes de rocas silíceas, en un bosque de *Quercus ilex* subsp. *ballota*, UTM 30TVK3580, *c.* 750 m alt., 19.ii.1995, Leg. V. Calatayud & C. Trescoli. VAB-lich 7706 (holotypus).

Description

Ascomata perithecioid, black, scattered in the host thallus (fig. 1), at the first stage completely immersed, later slightly erumpent, afterwards with the uppermost part easily observable externally, globose, of *c.* 200-300 µm in diameter, surface slightly rugose, ostiolar zone slightly depressed, with an irregular opening forming of radial fissures.

Exciple with the typical structure of the genus (see Navarro-Rosinés & Roux 1995), made up of two layers:

- External layer (15)-20-30 µm wide at the base, somewhat wider in the upper half of the ascoma, dark brown, pseudoparenchymatous (= paraplectenchymatous), provided with cephalothecioid plates in its upper half (Hawksworth, 1986).
- Internal layer formed by one or two layers of colourless cells.

Hamathecium formed by interascal filaments (paraphysoids, according to the concept of the French school of Chadefaud) septate, richly ramified and anastomosing, 1.5–2 µm wide. Without periphyses *sens. lat.*

Asci (fig. 2) with the typical structure of the genus, cylindrical or, in some cases, largely cylindrical-clavate, 110-145 × 12-16 µm, 8-spored, with the spores mostly uniseriately arranged.

Spores (fig. 3-4) of (22)-23-*25.8*-30-(32) × (7)-8-*8.5*-9-(10) µm (35

spores measured), with a long/wide ratio of (2.6)-2.7-*3.1*-3.7-(3.9), golden brown, ellipsoid, heteropolar (with one rounded apex and the other narrower and attenuated), constantly 3-septate, slightly constricted at septum level, provided with prominent tori, clearly visible in the young spores, more marked on the central septum. Inner perispore finely granulose, surrounded by a thin outer perispore (*c.* 0.5 µm), not conspicuous, only visible in some of the youngest spores.

Mycelium composed of 2.5-3.5 µm wide hyphae, emerging from the basis of the ascomata, with a slightly brown coloration and a finely granulose pigmentation in those cells closer to the ascomata, formed by



Fig. 1.—*Weddellomyces xanthoparmeliae* (holotypus). Habit of the ascomata, scattered in the host thallus *(Xanthoparmelia* cf. *protomatrae*).

Fig. 3

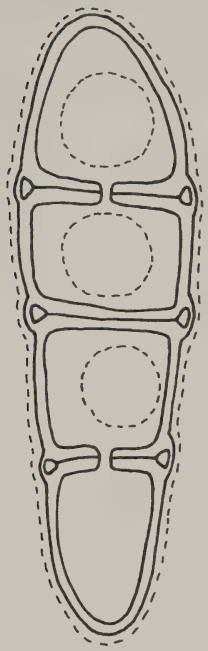


Fig. 2

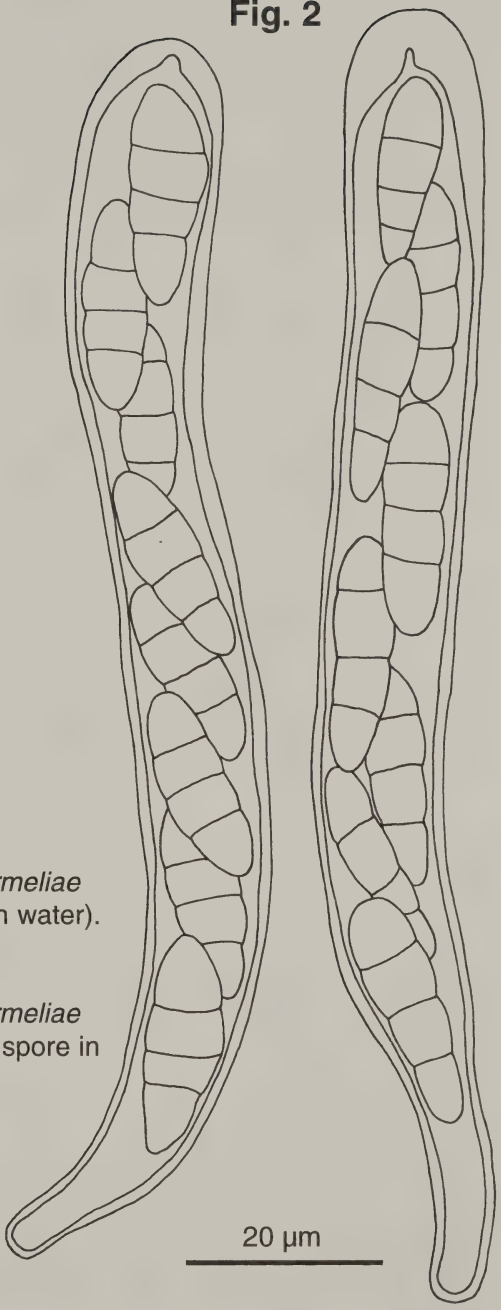


Fig. 2.—
Weddellomyces xanthoparmeliae (holotypus). Mature asci (in water).

Fig. 3.—
Weddellomyces xanthoparmeliae (holotypus). Structure of a spore in detail (in water).

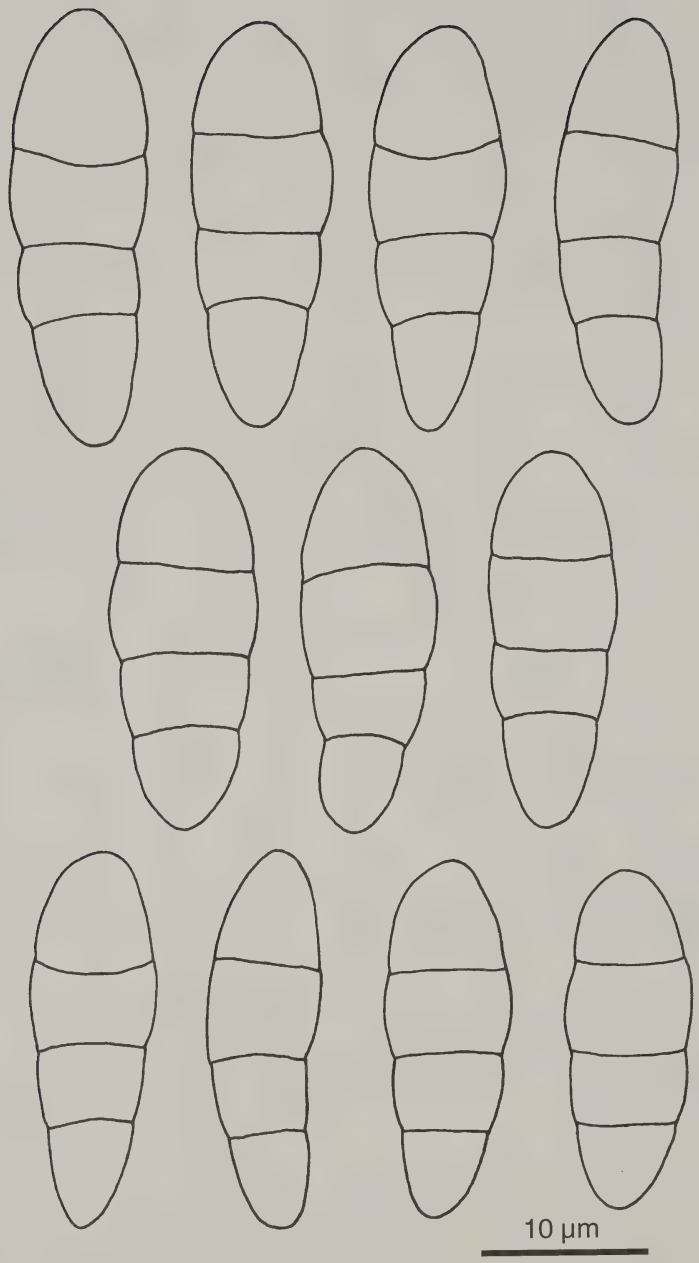


Fig. 4.—*Weddellomyces xanthoparmeliae* (holotypus). Size variability of the spores.

irregular cells, elongated [*c.* 10-17 × (3)-3.5-4.5 µm], thin-walled (wall thickness < 0.5 µm).

Reactions: All parts (both vegetative and reproductive) are I—.

Comments and affinities

W. xanthoparmeliae is the first species of this genus occurring on foliose lichen : *Xanthoparmelia* cf. *protomatrae*. Unfortunately, the material was too scarce to allow a chemical analysis that could help in confirming the identity of the host species.

W. xanthoparmeliae is characterised by having smaller spores than most of the species of the genus. Only *W. pachyosporicola* has spores of similar dimensions, slightly shorter, of (20)-21-*23.8*-26-(30) × (7)-8-*8.7*-9.5-(10) µm (Navarro-Rosinés & Roux 1995). However, both taxa clearly differ in the ornamentation of the spores: in *W. xanthoparmeliae*, the inner perispore is only finely granulose, while in *W. pachyosporicola* it is markedly granulose-verrucose, a characteristic that the latter species shares with *W. epicallopima* and *W. aspiciliicola* (Navarro-Rosinés & Roux 1995).

On the basis of the structure and ornamentation of the spores, *W. xanthoparmeliae* might be considered close to *W. erythrocarpae* (Navarro-Rosinés & Roux 1995) and *W. protearius* (Navarro-Rosinés & Roux 1997). However, in these species, the wall of the spores is only slightly granulose, in the former case, and smooth, in the latter case. With regard to *W. erythrocarpae*, its affinity with *W. xanthoparmeliae* would be closer because of the occurrence in both taxa, at least in the youngest spores, of prominent tori in the septa. *W. xanthoparmeliae* differs from *W. erythrocarpae* and *W. protearius* in the smaller size of the spores.

The size and shape of the asci is another distinctive character of *W. xanthoparmeliae* with regard to the rest of congeneric species. The asci are in general cylindrical, with a width of only 12-16 µm. In the other species of *Weddellomyces* known, the asci are in general clavate or cylindrical-clavate and wider, always over 18 µm wide. Only *W. aspiciliicola* shows cylindrical or almost cylindrical asci, but in this species they are larger, of (100)-130-180-(200) × (16)-18-22 µm (Navarro-Rosinés & Roux 1995).

Distribution and habitat

W. xanthoparmeliae is known only from the type locality previously mentioned, where it was found growing on the thallus of *Xanthoparmelia* cf. *protomatrae*. The host, which was abundantly infected by the fungus, grew between the squamules of the primary thallus of *Cladonia* sp., on soil evolved from siliceous rocks, within a *Quercus ilex* L. subsp. *ballota* (Desf.) Samp. forest.

Additional data on other species of *Weddellomyces*

Weddellomyces epicallopisma (Weddell) D. Hawksw.

Notes Roy. Bot. Gard. Edinburgh **43**(3): 512 (1986).— Bas. *Verrucaria epicallopisma* Weddell, *Mém. Soc. Nation. Sci. Nat. Cherbourg* **17**: 372 (1873).

New localities

Israel : Shefela, Jerusalem Rd. Km 32, on calcareous rocks. 7.iii.1969, leg. J. Deluria (GZU). On *Caloplaca aurantia.*

Italy : Basilicata, Prov. Potenza, NW-Abhänge der Coppola di Paola SE von Rotonda; ± lockere Eichenwälder bei *c.* 900-1000 m, Kalk, 31.v.1979, leg. H. Mayrhofer (GZU). On *Caloplaca flavescens.* — Basilicata, Prov. Potenza, überweidete Trockenhänge, *c.* 2.5 km E der Autobahnausfahrt Lauria Sud, E von Autobahntunnel, *c.* 800-850 m, Kalk, 3.vi.1979, leg. H. Mayrhofer (GZU). On *Caloplaca flavescens.*

Spain : Comunidad Valenciana, prov. Castelló, cerca de Coratxar, UTM 31TBF5208, 1300 m, sobre roca caliza, 2.x.1997, leg. V. Calatayud & E. Calvo (VAB-lich. 7826). On *Caloplaca aurantia.*

Comments

W. epicallopisma is a taxon previously known from different European localities, particularly from Germany (Baden-Württemberg: Hawksworth & Diederich 1991), Spain (Catalonia: Navarro-Rosinés & Roux 1995), France (type locality, near Poitiers: Weddell 1873, Hawksworth 1986; and Provence: Navarro-Rosinés & Roux 1995), British Isles (England and Wales: Hawksworth 1986), and Italy (Sardinia : Nimis & Poelt 1987).

The new localities are the first ones for peninsular Italy, and that of Israel is the first for Asia. A new locality is also reported for Spain (Comunidad Valenciana).

Weddellomyces heterochrous Nav.-Ros. et Cl. Roux

Mycotaxon **53**: 175 (1995)

New locality

Spain : Aragón, prov. Teruel, Camarena de la Sierra, Cerro de Javalambre, UTM 30TXK6841, sobre el suelo, entre pequeñas piedras, 2000 m alt., 1.xi.1989, leg. V. Calatayud (VAB-lich. 7822). On *Aspicilia desertorum* (Krempelh. pr. p.) Mereschk.

Comments

W. heterochrous was hitherto known only from the type locality (southern Catalonia, Spain), parasite of *Aspicilia calcarea*. This specimen grew as a parasite on an *Aspicilia* species of the same group. *W. heterochrous* is characterised by having spores with one or both apical cells paler, due to a smaller thickness of their walls, a characteristic that we have not observed in any of the other species of the genus (cf. Navarro-Rosinés & Roux 1995).

Weddellomyces aff. *protearius* Nav.-Ros. et Cl. Roux

Mycotaxon **61**: 434 (1997)

Locality

Austria : Steiermark / Oberösterreich: Dachstein-Gruppe, Gipfel des Hohen Dachstein, Kalk, ± 2990 m, 29.vii.1990, leg. J. Poelt (GZU). On *Xanthoria elegans* (Link) Th. Fr.

Comments

W. protearius has been described as a parasite of *Caloplaca proteus* by Navarro-Rosinés & Roux (1997). This new specimen growing on *Xanthoria elegans* is also refered to the same species, although we prefer to name it *W.* aff. *protearius* until more material for studies is available.

Both specimens show the same type of structure and ornamentation in the spores: without prominent tori in the septa and with an almost smooth perispore when examined with the light microscope. Nevertheless, we observe a slight difference in the size of the spores. In the type specimen, growing on *Caloplaca proteus*, the spores are slightly shorter and thicker on the average, of (24.5)-27-*29.7*-32.5-(39) × (10.5)-11-*12.1*-13.5-(14.5) µm (38 spores measured), with a long/wide ratio of (2)-2.2-*2.5*-2.7-(2.9) (cf. Navarro-Rosinés & Roux 1997), whereas in the specimen parasite of *Xanthoria elegans*, the spores are slightly larger, of (30)-31.5-*34.3*-37-(39.5) × (9.5)-10.5-*11.3*-12.5-(13.5) µm (31 spores measured) and with a long/wide ratio of (2.6)-2.7-*3.0*-3.5-(3.9).

At the moment, until more material of this taxon is available that could confirm or refute this slight divergence in the size of the spores, we prefer to consider the specimen growing on *X. elegans* as similar to *W. protearius*.

Compared with other similar taxa of the genus, *W. protearius* differs from *W. erythrocarpae* Nav.-Ros. et Cl. Roux, a parasite of *Caloplaca erythrocarpa*, in the absence of prominent tori in the septa of the spores. With regard to *W. heterochrous* Nav.-Ros. et Cl. Roux, as mentioned

before when commenting this taxon, the spores with a paler coloration in one or both apical cells are a distinctive feature of this species in contrast with *W. protearius* (cf. Navarro-Rosinés & Roux 1995).

Key to the accepted species of the genus *Weddellomyces* (1)

11 Spores (40)-49-66-(71) × 12-20-(24) µm, 3(4)–septate, provided with a thick halo (up to 10 µm). Asci 125-170 × 35-40 µm. — On *Aspicilia calcarea* —
***W. macrosporus* Nav.-Ros. et Cl. Roux**

1 Spores smaller, surrounded by a halo of 0.5-3 µm thick, usually scarcely visible.

22 Spore wall surface smooth or finely granulose.

33 Spores (22)-23-30-(32) × **(7)-8-9-(10)** µm. Asci 110-145 × **12-16** µm. Septa of the young spores with prominent tori. — On *Xanthoparmelia* cf. *protomatrae* —
***W. xanthoparmeliae* Calatayud et Nav.-Ros.**

3 Spores and asci larger. Spores **10-15** µm wide. Asci 100-160 × **20-26** µm.

44 Septa of the young spores with non prominent and usually not visible tori.

55 Spores (24.5)-27-32.5-(39) × (10.5)-11-13.5-(14.5) µm, long/wide ratio (2)-2.2-2.7-(2.9), (1)2-3–septate. — On *Caloplaca proteus* —
***W. protearius* Nav.-Ros. et Cl. Roux**

5 Spores (30)-31.5-37-(39.5) × (9.5) -10.5-12.5-(13.5) µm, long/wide ratio (2.6)-2.7-3.5-(3.9), (1)2-3–septate. — On *Xanthoria elegans* —
***W.* aff. *protearius* Nav.-Ros. et Cl. Roux**

4 Septa of the young spores with prominent tori.

55 Spores (28.5)-30-40-(45) × (10)-11-15 µm, uniformly golden brown, with a wall of constant thickness, (1)2(3) septate. — On *Caloplaca erythrocarpa* —
***W. erythrocarpae* Nav.-Ros. et Cl. Roux**

5 Spores (25)-26.5-35.5-(38) × (10)-11-13-(14.5) µm, with the apical cells paler and with a clearly thinner wall than central cells, (2)3(5)–septate. — On *Aspicilia calcarea* and *Aspicilia desertorum* —
***W. heterochrous* Nav.-Ros. et Cl. Roux**

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(1) This key modifies the one formerly proposed by Navarro-Rosinés & Roux (1997). Following Navarro-Rosinés & Roux (1995, 1997), *Weddellomyces peripheric us* (Taylor) Alstrup et Hawksw. and *W. tartaricola* (Lindsay) Alstrup et Hawksw. (see Alstrup & Hawksworth 1990) are not included, because they do not share the general features of this genus (Navarro-Rosinés & Roux 1995). A further species, *W. geographicola* (Arnold) Alstrup et Hawksw., also referred to *Weddellomyces* by Alstrup & Hawksworth (1990), is excluded since, according to Hafellner (1994), it is a taxon of the genus *Opegrapha*.

2 Spore wall surface clearly granulose–verrucose. Septa of the young spores with non prominent tori, usually scarcely visible.

33 Spores dark brown or black when mature, (21)-23-28.5-(30) × (9)-9.5-12-(13) µm, 3–septate, usually uniseriate. Asci of 100–200 × 16–22 µm, cylindrical. — On *Aspicilia (Lobothallia) radiosa* —

***W. aspiciliicola* Alstrup**

3 Spores pale brown or golden brown (in water!), biseriate. Asci claviform, never over 120 µm long.

44 Spores (21.5)-24-31-(38) × (9)-9.5-12-(13.5) µm, 2-3(5)–septate. Asci 90-120 × 20-25 µm. — On *Caloplaca* gr. *aurantia*, *C.* gr. *variabilis* and *Protoblastenia rupestris* —

***W. epicallopisma* (Weddell) D. Hawksw.**

4 Spores (20)-21-26-(30) × (7)-8-9.5-(10) µm, (1)2-3(4)–septate. Asci 80-90 × 18-20 µm.— On *Aspicilia contorta* and *A. coronata* —

***W. pachyosporicola* Nav.-Ros. et Cl. Roux**

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MYCOTAXON

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ONLINE RESOURCES FOR FUNGAL TAXONOMY AND NOMENCLATURE

PAVEL LIZOŇ
MYCOTAXON's *Editor-in-Chief*

Starting with next volume 70 (January-March 1999) Dr. Kathie Hodge <kh11@cornell.edu> who maintains the link site *Mycological Resources on the Internet* will regularly briefly review websites focused on taxonomy and nomenclature of both non-lichenized and lichen-forming fungi. Please be sure to inform her about your new or updated fungal and lichenological websites.

The following list is a reminder: set bookmarks in your Web browser for these important websites.

General Resources

DICTIONARY OF FUNGI http://biodiversity.uno.edu/~fungi/
Names listed in the 8th edition of the Dictionary: search for systematic position of genera and families, (book edition of the Dictionary was published by Hawksworth & al., 1995).

MYCOLOGICAL RESOURCES ON THE INTERNET
(WWW Virtual Library: Mycology) http://biodiversity.uno.edu/~fungi/
List of websites devoted to mycology and fungi: link from here to almost any fungal and lichenological website around the world. Your search for on-line data on fungi should start here.

INDEX NOMINUM GENERICORUM http://www.nmnh.si.edu/ing/
List of generic names of plants s. l. (time-to time updated): search for systematic position of genera, authors of taxa, type species of the genus and references (book edition of the ING was published by E. Farr & al., 1979)).

NAMES IN CURRENT USE 3
http://www.bgbm.fu-berlin.de/iapt/ncu/genera/
List of accepted generic names of plants s. l.: search for generic names and type species of the genus (book edition of NCU3 was published by Greuter & al., 1993).

INTERNATIONAL CODE OF BOTANICAL NOMENCLATURE
http://www.bgbm.fu-berlin.de/iapt/nomenclature/code/tokyo-e/
Full online version of the current Tokyo Code (book edition of the Code was published by Greuter & al., 1994).

AUTHORS OF PLANT NAMES
http://www.herbaria.harvard.edu/data/author/author.html
List of taxonomic authorities: search for standard abbreviations of their names (book edition of the APN was published by Brummitt & Powell, 1992).

US NATIONAL FUNGUS COLLECTIONS DATABASES
http://NT.ars-grin.gov/fungaldatabases/
Search cumulative indexes of SACCARDO'S SYLLOGE FUNGORUM (book edition of the Index by Reed & D. Farr, 1993), INDEX OF FUNGI (printed edition was published by CAB, 1940-1980) and fungus-host and distribution data from FUNGI ON PLANTS AND PLANT PRODUCTS IN THE UNITED STATES (book edition of the FPPP was by D. Farr & al., 1989).

INDEX HERBARIORUM http://www.nybg.org/bsci/ih/ih.html
Online version covering only USA: search for institutions and people (book edition of the Index was published by Holmgren & al., 1990).

MYCOLOGISTS ONLINE gopher://kaw.keil.ukans.edu:70/11/directories/mo
Comprehensive world-wide E-mail directory of mycologists and lichenologists; search also for E-mail addresses of authors of papers published in Mycotaxon (vol. 68-ff.).

LICHENOLOGISTS' AND MYCOLOGISTS' E-MAIL ADDRESS LIST
http://www.botanik.biologie.uni-muenchen.de/botsamml/lias/emaillist.html
Another E-mail directory: lists mostly lichenologists but also some mycologists.

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BOOK REVIEWS

Eric H.C. McKenzie, Book Review Editor

Hifomicetes demaciáceos de Cuba. Enteroblásticos by A. Mercado Sierra, V. Holubová-Jechová, and J. Mena Portales (1997). 388 pp., 240 x 170 mm. Museo Regionale di Scienze Naturali - Torino. Monografie 23. Orders: Museo Regionale di Scienze Naturali, Via Giolitti, 36 - 10123 Torino, Italy. ISBN 88-86041-19-5. Lit. 140.000 + shipping charges.

This book describes and illustrates 201 species of enteroblastic, dematiaceous hyphomycetes which are known from Cuba. These are species which produce their conidia either by protrusion of the inner wall through a pore in the outer wall of the conidiogenous cell (tretic), or by neither wall contributing to the conidium, and the conidium being extruded through an opening in the conidiogenous cell (phialidic).

A short, five page introduction is followed by a dichotomous key to the genera. The genera are then treated in alphabetical order, firstly the tretic species, and secondly the phialidic species. Each genus is described, followed by a description of the species. There are taxonomic citations for each genus and species. After a description of the species, the habitat (in Cuba), material examined, world distribution, and notes are given. Each species is represented by a line drawing of conidia and conidiophores. The drawings are of a uniformly high standard, and generally show all of the essential taxonomic features of the species. The book concludes with an alphabetical listing of host plants, and the fungi found on them.

Descriptions and illustrations of many species which previously were only available in hard to obtain publications are brought together in this book. Many of the original publications were poorly reproduced so that important microscopic details were often not visible in the drawings. The current book is a huge improvement. The only drawing I could criticise is that of *Polytretophora calcarata*, which fails to show the very distinctive pores in the conidiogenous cells. The decision to treat *Drechslera* in a broad sense, rather than to separate the genera *Bipolaris* and *Exserohilum* is, perhaps, unusual.

This book is a high-quality publication, not only in the contents, but also in the binding and paper which is used. It should be an essential holding for any person with an interest in the hyphomycetes, and it deserves to be shelved and used alongside classics such as the two books on dematiaceous hyphomycetes by M.B. Ellis. Most of the treated species are saprobes which were collected in tropical forests; these are, perhaps, not of direct interest

to plant pathologists. Although the book is in Spanish, it is relatively easy for an English speaking, non-Spanish reading person to decipher the essential information on each fungus.

E. McK.

The Genus* Pleurotus *(Fr.) Kummer (2) by Oswald Hilber. Illustrations (line drawings of spores) by Ruzena Hilber, coloured plate by M. Ameri (1997). 64 pp., 22.5 x 14 cm, softbound. Published by O. Hilber, Postfach 1342, D-93302, Kelheim, Germany. ISBN 3-00-001571-X. DM 38.00 (US$ 21.50) + shipping charges.

This booklet is an addendum to Dr. Hilber's justifiably famous *Die Gattung* Pleurotus *(Fr.) Kummer*, published as *Bibliotheca Mycologica* (vol. 87) by J. Cramer (Vaduz) in 1982. That book, also illustrated by Hilber's wife, with 448 pages, 172 line drawings, and 25 photographic plates (12 in colour), has been indispensable to workers on this genus, and has prompted many additional studies by other scientists worldwide. It was reviewed (in French) in *Mycotaxon 18*: 205, 1983.

Much of the new information presented here is the result of Hilber's taxonomic studies of American members of the *Pleurotus ostreatus* complex, done in Orson Miller's laboratory. The natural occurrence of the taxa is a main emphasis of this text, and it stands as an outline for a worldwide monograph of the genus *Pleurotus*, taken here in a restricted sense. Cultural characters are emphasized, the teleomorphs and anamorphs are separately described, macroscopically and microscopically, and ecology and geographical distributions are given. A mostly dichotomous key to the accepted species and varieties is provided. It will be necessary to refer to Hilber's 1982 monograph for full treatment of some of the taxa, where data is not repeated here. The taxonomic arrangement recognizes three subgenera within the genus, *Pleurotus* subg. *Pleurotus*, *P.* subg. *Coremiopleurotus*, and *P.* subg. *Lentodiopsis*, with two sections recognized in the last, *P.* sect. *Lepiotarii* and *P.* sect. *Calyptrati*.

One wishes that there were fewer typographical errors and mis-abbreviations, and more scrupulous attention had been given to nomenclatural rules. The new name *Antromycopsis ruzenae* is proposed for the anamorph of *Pleurotus dryinus*, but not formally, as the author states (p. 4) that since it lacks coremia it should be placed in a separate, undescribed, genus close to *Antromycopsis*. The name *Pleurotus cystidiosus* subsp. *abalonus* was published invalidly by Hilber in 1993, and appears here (p. 4) as a new combination, but again is unfortunately proposed invalidly. This addendum, long delayed in preparation by reasons of health, is nonetheless a major taxonomic contribution to this important genus, essential for all who work on the economically important genus *Pleurotus*.

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Fungi of Southern Australia by Neale L. Bougher and Katrina Syme (1998). xii + 391 pp., 240 x 170 mm. University of Western Australia Press, Nedlands, Western Australia 6907 (e-mail: uwap@cyllene.uwa.edu.au). ISBN 1-875560-80-7. A$75 plus A$20 postage and packing overseas or A$6 in Australia.

This book is a delight from cover to cover, combining the mycological knowledge of Bougher with the considerable artistic talents of Syme. It is a book to savour both the feel of, for it is extremely well-bound with both glue and stitching, and the sight of the beautiful watercolour paintings. All fungi are depicted with some of the surrounding vegetation and/or debris, and the fallen leaves and other plant parts are as engrossing as the fungi. Indeed, the inside cover is a captivating painting of fallen leaves - plus two or three fungi.

The book "...deals exclusively with the larger fungi" and in total 125 species of fungi are treated, including 9 ascomycetes. Only species found in south-western Australia have been included, but some obviously have a wider distribution, and are also found in Tasmania, south-eastern Australia, New Zealand, New Guinea, and south-east Asia; a few are cosmopolitan in distribution. The nomenclature is up-to-date with references to new combinations made by Grgurinovic (1997) in her book *Larger Fungi of South Australia* (reviewed in *Mycotaxon 68*: 518, 1998). Some idea of recent mycological activity in this part of the world can be gained from the fact that 44 of the included species have been either described or recombined into other genera since 1980.

Two pages are devoted to each fungus; usually a page of text plus line drawings of spores, basidia, or some other diagnostic microscopic features, and a ¾-1 page watercolour painting. There are six chapters (90 pages) of background information. This includes an introduction, which outlines the aims and geographic coverage of the book, and chapters about the naming of fungal species, their classification, collection, and description. The chapters are abundantly illustrated with line drawings, and are suitable reading for both beginners to the study of macrofungi and to those with more advanced knowledge.

For this book one typical specimen from Western Australia is described and illustrated. It is good to see that specimens have been deposited in two Perth herbaria. Full collecting details are also given for these specimens.

The book concludes with a glossary and a useful bibliography which is divided into seven sections including 'Field guides and illustrated books on Australian larger fungi' and 'Books on edible, poisonous, and hallucinogenic fungi'.

There are no rainforests in this part of Australia, but there is a high level of plant diversity and endemism. *Eucalyptus* spp. are a dominant feature of many forests, but *Acacia* and *Banksia* dominate some woodlands. *Pinus radiata* has been introduced as well as Tasmanian Blue Gum (*E. globulus*). These unique plants support some very interesting fungi.

To date about 500 species of larger fungi are known from this region of Australia. However, during preparation of this book, a survey of a nature reserve yielded 441 species of which 365 were new! With such limited knowledge of the higher fungi it is impossible

to estimate how many species may be endangered. Mention of the invasion of *Nothofagus* forests in Australia by the introduced *Amanita muscaria*, and the possible competition with indigenous fungi, draws attention to a 'problem' which is also developing in New Zealand *Nothofagus* forests, and has occurred elsewhere in *Eucalyptus globulus* plantations.

I recommend the purchase of this book to all lovers of fungi. It should be noted that limited edition prints of three original watercolours, taken from this book, of *Cortinarius rotundisporus*, *Rozites symeae*, and *Russula persanguinea* have been advertised elsewhere.

E. McK.

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ANNOUNCEMENTS:

CHANGED JOURNAL OFFPRINT POLICY

Increased costs force a regretted change in policy

Mycotaxon is no longer able to offer authors the free 100 offprints we have provided since 1992. Our journal was one of the last mycological journals to provide such free offprints.

Our new policy will automatically provide corresponding authors with one copy of their paper suitable for use in xerographic reproduction for producing their own reprints for distribution. For preparation of higher quality reprints than xerography allows, you must arrange for a local printer to print these from (i) your returned manuscript, or (ii) from the printed copy we provide, or (iii) from offset negatives used in preparation of the journal (which we can provide at a cost, currently $20 for each 10 or fewer pages).

The Editors and the Administrators of the journal deeply regret the inconvenience this policy will cause authors. We wish that the financial exigencies of publication would have permitted us to continue what was clearly a popular feature for authors publishing in *Mycotaxon.*

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Mycotaxon's Editor-in-Chief has accepted a position at the Institute of Botany (Slovak Academy of Sciences) in Bratislava, Slovakia starting January 1999. Please forward all your correspondence and manuscripts to his new address:

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ERRATA

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Page 391, illustration for *4* read *48*

VOLUME SIXTY-SEVEN

Page 369, line 26 for *Dasyscyphus niveus...*
read *Dasyscyphus.... = Dasyscyphella nivea*
Page 378, line 40 for *Phialea delavayi* read *"Phialea" delavayi*
Page 378, line 41 for *Plialea delavayi Pat. forma major*
read *"Phialea" delavayi ...*
Page 378, line 42 for *Phialea myricariae* read *"Phialea" myricariae*

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The Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume.

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